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ANNOUNCEMENTS

New York Section.—A meeting of the New York section will be held at the Engineers' Club, New York, on Friday, Feb. 20, 1914, at 8 p. m., preceded by an informal dinner at 6:30 p. m.

Bound Volumes.—Bound volumes of the bulletins published during 1913, including index, will soon be ready for distribution, and may be obtained from the Secretary at $1.50 a copy. Any member desiring a complete set of the bulletins for 1913, unbound, may obtain it without charge.

Annual Dues.—The annual dues of $10 are now owed. Members are requested to make their checks payable to the "Mining and Metallurgical Society of America." Members who desire the bound volumes of the bulletins for 1914 are requested to remit $1.50 extra. Bound volumes for 1914 will not, of course, be available until after the end of the current year, but it is desirable to know in advance how many will be wanted.

Subject of Discussion.—A member of the Society has communicated with the Secretary, asking if we cannot have a discussion upon the subject of "Should the Under-Graduates in Our Universities, Taking Engineering Courses, be Required to Have Previous Academic Training as is the Case in Law and Medicine? In other words, will it contribute to the benefit of the professions of engineering that our leading universities should make their courses in engineering post-graduate courses?" He adds that this subject interests him very much, and that he is anxious to have it discussed by engineers, particularly those who have been in the field for a number of years.

W. R. Ingalls,
Secretary.

MEETING OF COUNCIL

A meeting of the Council was held at the Engineers' Club, New York, on Tuesday, Jan. 13, at 5 p. m. The members present were Messrs. Chance, Ingalls, Kemp, Garrison, Munroe and Lindgren. Mr. Penrose was represented by proxy. The total number present in person and by proxy was seven, this constituting a quorum.

The Secretary reported that the New York section, at its meeting on Dec. 18, 1913, had rescinded its resolutions respecting recommendations as to a new code of mining laws. The rescinding of its action left the way clear to action by the Council upon the recommendations of the committee on mining law.

The recommendations of the committee on mining law, together with those of the New York section, and the replies of Mr. Winchell, were taken up paragraph by paragraph. Referring to the recommendations as published in bulletin No. 59, pp. 93-94:

Paragraph 1 was approved as it stands. It was voted that paragraphs 2, 3 and 5 be put before the membership of the Society, as written by the committee on mining law, but that the alternatives recommended by the New York section be also put, and the members of the Society be given the opportunity to vote for one or the other in each case.

Paragraphs 4, 6, 8, 9 and 10 were approved as written by the committee.

Paragraph 7 was amended to read as follows:

"Notice of mining locations should be so recorded as to give the fullest possible public notice."

It was moved and seconded that the resolutions drafted by the committee on mining law, and amended by the Council, be submitted to the membership of the Society for vote, yes or no, on each paragraph; and moreover that a statement respecting these resolutions, including the criticisms of the New York section, and Mr. Winchell's replies thereto be prepared by the Secretary and be issued with the ballot. This motion was unanimously carried.

Upon motion, duly seconded, it was voted that the Secretary issue the ballot on the mining law resolutions as soon as possible.

Professor Kemp presented his resignation as Councillor, which resignation was accepted. George C. Stone was elected Councillor in place of Professor Kemp, resigned.

W. R. Ingalls,
Secretary.

ANNUAL MEETING.

The annual meeting of the Society was called to order at the Engineers' Club, New York, on Jan. 13, 1914, at 2 p. m., Dr. H. M. Chance, the President, being in the chair.

The President, having called for proxies and these having been counted, announced that 92 members were represented by proxy, and that eight were present in person, a total of 100, this constituting a quorum. Several more members came in later.

The President stated that the minutes of the last previous meeting of the Society, viz., on Feb. 28, 1913, having been printed in bulletin No. 58, would be declared approved as there printed, if no objections were offered. No objections being offered, the minutes of the last previous meeting were declared approved.

The tellers appointed to canvass the vote for election of officers for 1914 reported as follows:

H. M. CHANCE,
President.

We beg to report as tellers to canvass the votes for the election of officers for 1914, as follows:

The total number of members entitled to vote was 220. The number of ballots received was 140, of which three were rejected because of being unsigned, and five of the ballots cast were blank.

For the office of president, J. F. Kemp received 65 votes; H. M. Chance, 39; H. V. Winchell, 28.

For the office of vice-president, J. R. Finlay received 66 votes; S. B. Christy, 62.

For the office of secretary-treasurer, W. R. Ingalls received 131 votes; E. G. Spilsbury, one.

For councillor in districts 1-2-3, J. Parke Channing received 70 votes; G. C. Stone, 34; H. H. Knox, 18.

For councillor in district 6, H. Jennings received 58 votes; E. W. Parker, 24; A. H. Brooks, 22; G. O. Smith, 8.

For councillor in district 7, P. N. Moore received 44 votes; W. Kelly, 33; W. N. Merriam, 21.

For councillor in districts 9-10, H. F. Bain received 82 votes; M. L. Requa, 22; R. E. Browne, 14; E. H. Nutter, 5; J. B. Keating, one.

E. G. SPILSBURY,
F. W. PARSONS,
Tellers.

Jan. 13, 1914.

The President declared J. F. Kemp to have been elected President for 1914; J. R. Finlay, Vice-President; and W. R. Ingalls, Secretary-Treasurer. He furthermore declared J. Parke Channing to have been elected councillor for districts

1-2-3; Hennen Jennings, for district 6; P. N. Moore, for district 7; and H. Foster Bain, for districts 9-10.

The Secretary-Treasurer then presented his reports. (These reports are printed elsewhere in this bulletin.) Upon motion, duly seconded and unanimously carried, the report of the Secretary was approved and was ordered to be placed on file. Upon motion, duly seconded and unanimously carried, the report of the Treasurer was accepted and ordered to be placed on file. The President then delivered his annual address. (This appears elsewhere in this bulletin.)

There being no further business the meeting was adjourned to 8.15 p. m.

The evening session was called to order by President Chance, after an informal dinner at the Engineers' Club, the unfinished business being the award of the gold medal of the Society.

The President.—It is now about three years since the award of a gold medal by the Society was first proposed. The suggestion was discussed by the Society, and by its local sections, and it was finally decided that a gold medal should be awarded each year for "conspicuous or public service for the advancement of the science of mining, of metallurgy or of economic geology; for the betterment of the conditions under which these industries are carried on; for the protection of mine investors, and especially for the better protection of the health and safety of workmen in mines and metallurgical establishments," and that the medal should "be awarded at the annual meeting of the Society in January."

Certain rules were adopted by the Society providing for the determination each year of the specific purpose for which the award should be made, and for the nomination, by a committee appointed for the purpose, of two candidates, whose names should be submitted to the council for letter-ballot.

A committee was apointed to secure designs for the medal, one of the designs, which has already been printed in the bulletin, was adopted, and a bid from Tiffany & Co. for its manufacture was accepted. A committee was duly appointed to determine the subject for which the award was to be made for 1913, and to present two candidates to the Council. That committee, after soliciting suggestions from the members of the Society, decided that the medal for 1913 should be awarded for "Distnguished Contributions to the Literature of Mining," and presented the names of two candidates to the Council; the Council duly recorded its selection by letter-ballot.

All of the formalities required by the rules governing the award having thus been complied with, it remains now merely to comply with the requirement that the award shall be made at the annual meeting of the Society in January. In compliance therewith I therefore declare that the gold medal of the Society is now awarded to Herbert C. Hoover and Lou Henry Hoover, for their "Distinguished Contributions to the Literature of Mining." [Applause].

It must be gratifying to all of us that a member of the Society and his wife should have been found entitled to receive this first award of the medal. The splendid services they have rendered to the profession are not only of great present value, but will be remembered long after all of us shall have passed away.

As it was not possible to have Mr. Hoover and his wife present at this meeting, the Council has decided to have the presentation of the medal made at a dinner to be given at a time to suit the convenience of Mr. and Mrs. Hoover. The members will be duly notified of the time and place at which this dinner will be given.

I am able to speak only in the most general terms of the work of Mr. and Mrs. Hoover in translating into English the great work of Agricola, and I shall therefore ask Mr. Channing to describe this work, and the services rendered by them.

J. Parke Channing.—I am sorry that Mr. Hoover is not here with his wife to acknowledge to the Society his appreciation of your award. As a personal friend of his I shall endeavor to speak for him and for Mrs. Hoover. Mr. Hoover and his wife are both graduates of Leland Sanford University, and after having lived for many years in London, are now returning to San Francisco, where they intend to live. Mr. Hoover, I understand, has just been elected a trustee of his Alma Mater.

In my opinion Mr. Hoover is the most distinguished mining engineer that America has produced. Not only is he a thorough technical man, but he combines with it a keen business judgment. His work entitled, "Principles of Mining," is a classic, and is in the hands of probably every engineer who is under the necessity of valuing mines.

The literary work for which Mr. Hoover is honored tonight is a translation and reproduction of Agricola's "De Re Metallica." Agricola was a German named George Bauer. His work was written in the 16th century, and as was customary at that time, was published in Latin, under the pseudonym of Agricola. His work was profusely illustrated, and Mr. and Mrs. Hoover, after translating the text into English, have had the cuts reproduced, and the book is as near a reproduction of the original,

both as regards paper and binding, as may be. In making the translation Mr. and Mrs. Hoover have done a large amount of research work, and the foot-notes are probably as interesting as the text itself. Great difficulty was experienced in translating the old standards of weights and measurements into those of modern days. The work has cost Mr. and Mrs. Hoover not only a large amount of money, but a great expenditure of time and patience; it, however, makes available to the mining profession of to-day the earliest known work on mining, and shows that while there have been great advances, still there is not so much that is new.

In awarding the medal jointly to Mr. and Mrs. Hoover, I am glad to see that the Society has shown itself progressive and appreciative of the femininist movement. I trust that the time will not be far distant when women may be eligible to membership in the Society.

The President.—We have no other business to transact, except possibly, new business, for which an opportunity will be afforded before adjournment. Mr. Jennings has kindly consented to tell us something about recent progress in gold mining in Alaska.

The Gold Mines Back of Juneau.

Sidney J. Jennings.—The most dramatically interesting developments in the mining and metallurgy of precious metals are taking place back of Juneau, Alaska. A zone, some 20,000 ft. long by 1000 ft. wide in its widest point is being developed by three companies; the Alaska Gold Mines, which owns some 12,000 ft. along the strip, the Alaska-Juneau, which owns some 5000 ft., and the Ebner, which owns 3000 ft. This zone consists of a belt of slate in which quartz lenses and stringers occur with more or less irregularity. The gold contents in the pure quartz, that is, in the center of the lenses, are practically negligible, and the gold in the slate itself is also very small in amount. The gold seems to occur chiefly at the contact between the quartz and the slate. Values as high as $90 a ton for a width of 8 in. have been found, but a recovery of $1.50 is estimated for the whole mass that will be mined.

When such low recovery is anticipated, the conditions for cheap working must be extremely favorable; and the scale of the operations will have to be great and the skill with which they are conducted high in order to assure adequate returns for the large amount of capital that will have to be invested. Naturally, the method of mining such a deposit, and the costs that will be incurred in mining, have received a great amount of attention. In the case of the Alaska Gold Mines a system has been worked

out which promises favorable results. The footwall of the deposit, as far as they have developed it in their property, is fairly well defined by the fact that quartz lenses and stringers occur with greater persistence and regularity on the footwall than anywhere else. This wall dips approximately 55 deg., and they estimate that the silicification of the slate extends out for an average of 35 ft. from the footwall, although many of their crosscuts show a much greater width than this. A drive is carried parallel to the footwall in the country rock. At a height of about 30 ft. above this drift a parallel drift is likewise carried in the footwall. This upper drift is called a "chute-tender's drift." Crosscuts from it at intervals of from 30 to 50 ft. are driven into the vein. From these crosscuts, stopes are opened out 7 or 8 ft. high and for the full width of the vein, say 35 ft., and the ore broken in these stopes is mucked into chutes which lead from the crosscuts to the working level. Stopes are then raised on the footwall of the vein for from 20 to 25 ft. high, and at the end of a stope, say 200 ft. long, the vein is stoped clear across from the footwall for as great a distance as commercial recoveries are found. They thus prepare a block of ground which is some 200 ft. long by 20 to 25 ft. high, which is undercut on the bottom, on one side (the footwall) and at two ends, and experience has proved that this block of ground will cave. The roof that remains after it has dropped, gradually slabs off until it assumes a position approximately at right angles to the footwall, when it is quite safe again for the men to enter on the top of the broken ground and start their footwall stope once more. They thus actually have to mine only one-fifth of the ore sent to mill, the remaining four-fifths breaking itself.

Such a statement seems like a fairy tale. It did to me when it was first made; but after having examined the stopes where the Alaska Gold Mines has broken some 400,000 tons by this method, I am inclined to believe, under the conditions existing in their property, and with the amount of silicification of the slate so far exposed by their development, that it will work.

Grizzlies are laid on top of the chutes before mentioned, and should these grizzlies become blocked by large lumps, the chute-tender going along the drift can in perfect safety bulldoze such lumps and keep the chute filled. These chutes are designed to hold 125 tons—approximately one trainload. The train will consist of flat cars and will be trammed either by endless wire rope or electric locomotive to the main chutes where the ore will be plowed off these cars by a stationary plow, dropping the ore to the Sheep Creek tunnel level. At the start, this drop will be some 1400 ft., since the working of the mine will naturally commence at the part of the vein near the outcrop. The ore on the

Sheep Creek tunnel level will be trammd in trains drawn by electric locomotives to the mill, which is located on the Gastineau Channel. In the mill the ore will be broken in crushers and rolls, and a large proportion roughed off, leaving only a small percentage to be finely ground, amalgamated, and concentrated.

To most men familiar with gold mining, the crushing of gold ore with rolls is contrary to the vast bulk of experience. Rolls have been tried in the treatment of gold ore at many times, in many places, by many men, and so far with not sufficient success to warrant their installation on a large scaale; but D. C. Jackling, who is responsible for the methods used in the Alaska Gold, is so confident, from the result of numerous experiments made with rolls, that rolls will be the best means of crushing for the particular class of ore found in the Alaska Gold Mines, that $4,000,000 has been raised from the public to carry out his ideas on a very large scale.

The Alaska Juneau has the maximum width of 1000 ft. on the slate belt. This company has driven a tunnel at an elevation of 350 ft. above sea level, and has crosscut the belt in the tunnel, where it appears to be 700 ft. wide; but owing to the fact that the tunnel cuts the belt at an angle, the actual width of it is about 500 ft. Owing to this great width, the Alaska Juneau cannot utilize the method adopted by the Alaska Gold Mines, and will have to try some modification of a room-and-pillar method of stoping, combined with a caving process. At the start the ore will be supplied from a quarry at the surface. The broken ore will be scraped by Oregon scrapers into a rock house, where it will be coarsely crushed and sorted by hand. The sorted material will be dropped through a chute to the tunnel level and trammed to the mill, which will be likewise located on the Gastineau Channel. Mr. F. W. Bradley, who has had great experience in treating gold ores on Douglas Island, has decided to use stamps in the mill. Mr. Bradley anticipates having a mill of a crushing capacity of 600 tons per day ready during the coming year. In front of the stamps he expects to install machines which will carry out his flow sheet, as determined by the small experimental plant; but he realizes that this flow sheet will in all probability have to be modified when working on a large scale. The main idea of the flow sheet is to crush the ore to such a fineness that a large proportion of it can be roughed off, leaving only a small percentage to be finely crushed, amalgamated and concentrated. The money for the work on the Alaska Juneau is being put up by Mr. Bradley and a few of his immediate circle, for while he is reasonably sure from his long experience on Douglas Island that a large percentage of the gross return from this slate belt can be realized as profit, he is not sufficiently sure to ask the public to

come in and subscribe the large amount of money that will be needed absolutely to demonstrate this fact.

It is the race between the two ideas in the metallurgy of gold ores, as represented in the Alaska Gold and the Alaska Juneau, which forms the dramatically interesting feature of the situation. The Alaska-Ebner is driving a tunnel to develop its section of this slate belt, and it will be able to profit by the large amount of work done by the Alaska Gold and Alaska Juneau in determining which method of milling will yield the more economical result. The mills of all these companies will be on the Gastineau Channel, and, while no serious menace to navigation has been produced so far by the milling on Douglas Island, when amounts of 6000 to 20,000 tons per day shall be discharged into the channel, some other means than the mere wash of the tide will have to be utilized to get rid of the tailings. Probably tailing flumes two or three miles long will have to be provided to carry the tailings along the shore into very deep water.

The President.—Mr. Jennings has referred to several interesting developments. In one of them I am much interested, because I have been considering the use of the method of scraping iron ore from flat cars underground into loading pockets by a fixed plow, just as he has described the plan to be used at these Alaska mines. Another interesting development is the adoption of crushers and rolls in place of stamps. I understand Mr. Barbour has recently installed such a plant in North Carolina, and I will ask him if he cannot tell us of his experience in that direction.

Percy E. Barbour.—We have just started a new mill in which all the crushing between rock breaker and tube mill is done in rolls. This arrangement was adopted after considerable thought and study of the problem, and in face of the fact that the adjoining property has a mill of the same capacity, treating the same ore, and using stamps which are, it is interesting to note, the heaviest in this country, 1750 lb. One reason why we were glad to consider rolls was because the only suitable mill-site on our property was on the hanging-wall side of our Montgomery vein, and 1750-lb. stamps, dropping on this mill-site would have necessitated either much timbering or the leaving of a big pillar of ore. The roll problem was carefully considered from all angles, of course, and the results of operation thus far bear out the wisdom of the choice. The first cost compared favorably with the installation of stamps; the labor for operation is so small that one man per shift looks after two sets of rolls, the tube-mill, and the agitators; the horsepower required is satisfactorily low, as shown by indicator cards taken with, and without, rolls run-

ning at maximum feed. Having just started within a month, we are not yet able to tell anything about roll-shell consumption. Consideration was given to various types of rolls equipped with automatic fleeting devices; experience seemed to indicate a questionable benefit from them, and we therefore put in plain, old-fashioned rolls.

J. Parke Channing.—The first rolls which we put in at Miami, which were designed by H. Kenyon Burch, were provided with a fleeting motion designed by him. The ore was so hard, however, that the mechanism was soon shaken to pieces. The next rolls we put in were a modification of the Burch roll, made by the Traylor Engineering Co. While this fleeting device was an improvement, it also racked itself to pieces and failed to prevent corrugating. The speed of the mechanism was such that the moveable roll was moved backwards and forwards once a minute. Within the last few months Mr. Traylor has invented a new device in which the movement is made by pawls working on a ratchet wheel, and the movement of the roll has been so reduced that a cycle is now completed in 30 min. instead of one minute. This seems to have entirely solved the problem, and we are now putting this mechanism on our 42 x 16-in rolls for fine crushing in the mill proper. Here the rolls run face to face, and the friction in attempting to make the movement in one minute was altogether too great.

Mining Conditions in South Africa.

The President.—Mr. Rogers has kindly consented to tell us something of his experiences and of mining conditions in portions of South America.

Allen H. Rogers.—I can hardly pretend to be able to speak of mining conditions in South America in general, but I have recently made two trips to that continent, to Peru and Chile, and perhaps may be able to say something of interest about those countries.

Either may be reached from New York via the Isthmus of Panama. There are several lines of steamships from New York, reaching Colon in from six to nine days. Crossing the Isthmus by rail, you may take any one of three lines, the English, the Chilean, or the Peruvian. The Chilean line is now owned by the English company, and the boats of either are fair. It used to take at least three weeks to get to Valparaiso from Colon. Within the last three years, however, certain of the boats are denominated express boats, making fewer stops than the others, so the voyage to Valparaiso may be made in a little less than two

weeks. The voyage along the coast is interesting and the weather invariably fine. Chile may also be comfortably reached via Southampton, taking the Hamburg-American or the Royal Mail boats to Buenos Aires, thence crossing to Chile by rail. This journey will take four or five weeks. It is a very pleasant way to go, but should not be attempted during the winter season in the Andes, as then the railway service on the Trans-Andean is very irregular.

The mines in Peru are all located in the Andean highlands at elevations rarely less than 12,000 ft., and commonly at 15,000 ft. or above. Cerro de Pasco is a little above 15,000 ft.; the smelter somewhat below. As a result of this altitude, conditions are very difficult. Up to 10,000 ft. elevation, I find, personally, but little ill effect from altitude. Beyond this elevation I find that difficulty in the exercise of muscles, and breathing, increases very rapidly, and it has been the general experience that at these high altitudes the efficiency of labor suffers severely. With some men, these altitudes are absolutely impossible, through their ill effect on physiological functions, and the Cerro de Pasco company has had many instances of men who could remain but a day or two before having to return to the coast. Its effect on me was only as I mentioned except that, the first few nights, I had a fearful feeling of suffocation. A common effect, which is generally not permanent, results from the rapid ascent from Lima. Leaving this point, which is but a few hundred feet above sea level, at seven in the morning, you reach Ticlio pass at one in the afternoon, where the altitude is about 15,600 ft. This rapid ascent brings on an attack of what is called there "sorroche," manifested by a feeling of general debility, short breath and, frequently, vomiting.

The climate, too, in these highlands is very disagreeable. Although nearly under the equator, it generally freezes at night and snows during the summer season. The sun next day melts the snow, so that the whole country is a bog. During the winter there is no snow, and conditions are a little pleasanter.

Labor is generally Indian, and the standard is not very high. The men do not seem to be severely affected by the altitude but, undoubtedly, it has something to do with the low efficiency. They have extraordinary staying powers, and will often work 48 hours without sleep, or anything to eat other than the coca leaves which they chew at frequent intervals.

From the economic standpoint, transportation is the most difficult feature. There are but few railways, and in most cases, transportation to some extent must be effected by pack animals, generally llamas. This is very expensive and, as a consequence of this and the other unfavorable features, only ore of the highest

grade will pay. There are a great many mines in the country but, until transportation facilities are improved, most of them must be idle. A trip to examine one of these is about as disagreeable an experience as I know.

On the other hand, an examination trip to Chile is very delightful. Here most of the mines are located at moderate altitudes, the climate is pleasant, and the people of the better classes charming. I know of no more delightful place at which to stop than Santiago, the capital. The hotels are fair, and there is an excellent club with a good restaurant. The upper class Chileans are very pleasant people to meet, and very enterprising, too. It is remarkable how many speak English well. The government is very liberal in encouraging the development of the country's mineral resources, and altogether, I have nothing but the pleasantest recollections of my business and social relations there.

Chile, as you know, occupies a narrow strip between the Andes and the coast. It is about 2700 miles long from north to south and averages about 120 miles wide. Hence, it is easily accessible in all parts from the coast. In the northern part the land rises rapidly from the ocean, but from the central part south there is a coast range which rarely attains altitudes greater than 4000 or 5000 ft. Between this range and the Andes is the Central Valley, a fertile stretch of country where, under irrigation, anything will grow. Very fine fruits are grown and the grape industry is important, wherefore good wines are plentiful and cheap.

Most of the mines now worked are located in the coast range and are, therefore, at comparatively low altitudes. Then, too, they are generally easily accessible, and climatic conditions are favorable. Labor is furnished by the lower classes, locally known as "rotos," who are mostly half-breeds and much like the Mexicans, both in efficiency and habits. They have a constitutional objection to the use of water, and get as drunk as possible on every occasion. Transportation is available, not only by the coastwise vessels, but also by many railroads. The Chilean government for a number of years has been building the Longitudinal Railway, so-called, to extend from the northern to the southernmost limits of the country. This is more than half completed. It is a broad-gauge line (5 ft. 6 in.), and well built and equipped. At various intervals there are railways running back from the coast. These are of various gauges, and while some of them are owned by the government, the majority are private enterprises.

There are some exceptions to the statement that the mines are located in the coast range In the northern part of the country the coast range is not represented, the Andes approaching

close to the coast. Hence, the mines of this section are generally at high altitudes. In the central part of Chile there are also a few mines in the Andes. The most important of these is the Braden, and as the property is owned by Americans and as I was quite familiar with it a few years ago, perhaps a few words about it might be of interest.

The Braden property is located about 60 miles southeasterly from Santiago. It is reached via the Longitudinal Railway to Rancagua, 48 miles south of Santiago, and thence 42 miles by the company railway, easterly. The ore deposit, which is located on a spur of the Andes at altitudes from 8000 to 9000 ft., consists of diorite impregnated with copper minerals around the periphery of a mass of tuff, roughly circular in plan, and presumably an old crater neck. The copper minerals consist mainly of chalcopyrite and bornite, with some chalcocite. The impregnation extends outward from the contact of the tuff and diorite to distances varying from 100 to 300 ft. The ore is generally richest at, or near, the contact, and its other limit is generally a commercial one. The crater is over 4000 ft. in diameter and its periphery measures about 2½ miles. It is mineralized all the way around, and a surprising proportion of it is of paying grade.

The ore is mined in shrinkage stopes with pillars between, which are afterwards removed by caving. It is dropped to a tunnel on a level with the mill bins and trammed by electric power to the mill. This will be eventually of 3000 tons' daily capacity, and combines ordinary concentration with the Minerals Separation flotation treatment. Some of the concentrates are reduced by smelting but, as Mr. Smith described to us a few meetings ago, part of them are roasted and leached and the copper precipitated electrolytically, and I believe it is the intention eventually to treat all in this way. The property includes an excellent water-power site which has been developed to produce 14,000 kw., although, at present, equipment for but 6000 kw. is installed. The property is the highest in grade of any of the "porphyries," and undoubtedly contains a very large tonnage of ore.

We have also heard here of Chuquicamata, another very large copper deposit located in Chile, and I believe these are not all of them. The mineral resources of the country are very extensive and, exterior conditions being favorable, the situation merits more attention than has heretofore been accorded it by American mining concerns. With Mexico out of the question, as at present, and the Panama canal completed, I look for Chile to attract more attention in this country, and I think a proper investigation of the situation will be well repaid.

New Methods of Ore Extraction.

The President.—Professor Kemp's troubles will begin after this meeting adjourns, but we have prevailed upon him to tell us about methods of extracting metals without mining the ore, it being, of course, understood that nothing that he may say (prior to adjournment) is to be taken seriously.

James F. Kemp.—The newly elected President desires, first of all, to express to the members how deeply sensible he is of the honor conferred, and his profound desire to serve the Society and co-operate with the Secretary in the plans for a fruitful year. One thing can be said in his favor. The Society is not taking such a big Chance as it took last year.

The Secretary has requested that I speak upon the subject, "How to get the metals out of the earth without mining." There are several ways in which this can be done. Some years ago, as preparatory to a profound and thorough discussion of ore deposits, W. P. Jenney formulated a scheme of classification, viz.:

1. Mines
2. Prospects
3. Bilks.

From time immemorial, or certainly from the time of Agricola, as we learn from Hoover's translation, the yellow metal has been extracted from the third kind of ore deposit without mining, and by methods so generally familiar that I need not describe them. We have, therefore, essentially, to do with the first two. It is, in the first place, possible to treat these by a method recently set forth by one of our younger American poets. The versifier prepared an alumni-song for one of our institutions from which several kinds of engineers, mining, civil, electrical, mechanical, etc., were being graduated, but it is adapted to almost all to which this description applies. We may sing: "We're from Fair Harvard," or, "We're from Cornell, Sir," or, "We're from Columbia," as we like, but out of regard for our Secretary I will use it as follows:

"We're from Technology,
Miners are we,
Seeking the ore
From mountain to sea
Sometimes we blast it
Out of the rock,
Sometimes we just
--Sell stock."

A third method I first heard discussed in connection with the beach placers on the Pacific coast of southwestern Oregon.

It was a fruitful cause of great trouble to uncover the black sands, and to be bothered with buried driftwood and the like, so that one operator proposed to pump into his placer a cyanide solution and then pump it out again and precipitate the gold. But, as it was evident, upon reflection, that the Pacific Ocean would probably come too, the plea was not adopted.

Nevertheless it has its merits and I now propose to apply it to dredging claims, to dry placers, and above all to those in narrow gulches with extra large boulders. We all are familiar with the difficulties met by the dredging companies because of the objections which unsympathetic people raise to the destruction of orange groves, cemeteries, and the general ruin of the fertile land. We have all felt, too, the enormous expenditure of effort, when we have watched the procession of buckets come up from the muddy depths; A cubic yard of ground removed to get five cents' or ten cents' worth of gold; all this sand and gravel just for a lot of colors which altogether total a twentieth or a tenth of an old-fashioned gold dollar. Any process which will lessen this huge expenditure and prevent the ruin which follows in its wake deserves the serious attention of all who are interested in conservation.

The method was suggested by the Brooklyn water works. You know that the water supply of the old city, now the Borough of Brooklyn, is obtained by going out on Long Island and putting down a series of driven wells in groups, each group being connected with a suction pump, which draws up the ground-water and starts it on its way to the city. The method has been stopped from further expansion by the suits of neighboring property owners, whose wells ran dry and whose crops perished from lack of water. But the method proved that the rain water which percolated into the ground could be pumped out again. If therefore into a series of gold-bearing gravels we introduce a cyanide solution through a series of peripherally driven wells and pump it up from a central one—we will bring out the gold and not injure the surface for farming, orchards, burial plots, or similar uses. If the cyanide solution were to get into the underground water supply it might, in fact greatly, increase the efficiency of the cemetery and actually raise the value of the land instead of leaving it a worthless waste, as is the case to-day. Cyanide solutions in the mills require only 12 to 24 or 36 hours, and while this might be lengthened somewhat in the ground, yet the saving of time over a dredge would be enormous, reducing the interest on investment and involving a great decrease in amortization charges. Depth also would cut a much less serious figure, and pay streaks could be reached which are now below the buckets of

the most powerful dredge. The greater the number of groups of wells, the faster would be the removal of the gold, and the less the idle investment.

If, however, we had a property in a narrow gulch or valley, with a good bed-rock and with huge boulders,—not at all an uncommon experience—we realize that the boulders would be a great help instead of being, as to-day, a tremendous handicap. Being impervious they would operate to confine the solution to the productive sands. Thus if we had two thousand billion cubic yards, each yard with ten or twenty cents in gold, and we pumped out all the gold in thirty days, it would be something worth while.

The fourth method which I have to present does not entirely do away with mining, but it does avoid the necessity of removing the ore, except in comparatively small amount, from the ground. It is especially adapted to sulphides, such as the intermingling of pyrite or pyrrhotite with chalcopyrite, in the great lenses in schists and slates, "Typus Kieslager." I specially commend it to my neighbor opposite, Mr. Parke Channing, for Ducktown, Tenn.

The plan involves sinking a shaft, as now, through the gossan and for at least one hundred feet, at the outset, into the solid sulphides. Then drift off with a level leaving a good thick pillar behind and next to the shaft. Then, with overhand stoping, begin working upward with a slice of suitable width, breaking the ore quite fine with extra charges of powder, and allowing it to fall first on a lot of cribbed cordwood. Having gone upward, say eighty feet, arrange a series of suitable flues for the outward and upward passage of sulphurous fumes under perfect control, and then, by means of the cordwood, fire the pile of broken ore. Meantime, a sulphuric acid plant will have been erected on the surface, to which by means of the flues above described, the fumes will be conducted and manufactured into weak vitriol. Now let us assume that while the fumes are coming from one or more roasting stopes, we already have one or more old ones fully roasted, so that the weak vitriol may be conducted to them as fast as made, and sprinkled upon them so as to leach out the copper. The copper sulphate solution would then be collected at the bottom of the piles, and pumped up to the surface to be precipitated on the old tin cans from the miners' boarding house, and the superintendents palatial quarters, or from any old source. No sulphur fumes from out-door roasting piles of ore would ever destroy vegetation, vitiate the atmosphere, and bring smoke legislation to pass; almost no expensive hoisting would be done; practically no change would be made in the surface of

the earth, except to adorn it with pale green or sky-blue rippling and gurgling rivulets of copper sulphate solution.

The same general method could be applied to the galena of southeast Missouri, and I only regret that I did not think of it in time to have had my friend Arthur Thatcher, over there on the opposite side of the table, use it at the Central mine when he was in charge. The details would be different, however, with lead. We would have to use the acid in the manufacture of fertilizers, which would be on the whole, fortunate because thereby fresh vegetables would be furnished the miners' boarding houses, and we could cut off canned goods, as we have no use for the empty cans. The galena would be, by a proper management of the flues, partially roasted to sulphate. Then by shutting off the supply of oxygen, and producing reducing conditions, the hot unroasted sulphide would react on the sulphate, setting free a stream of metallic lead, exactly as in the old-time roasting and reduction process. All we would need to do now, would be to keep this stream of melted lead hot, and pump it right up to the surface to be cast into pigs. I know of no more gladsome sight in mining than a bright silvery fountain of metallic lead spurting up from the dark, underground caverns of a mine.

At the moment I do not think of any other processes.

Allen H. Rogers.—What Professor Kemp has just said reminds me of a similar scheme tried in Arizona not long ago. In a certain property there is developed, by drilling, a small tonnage of low-grade, disseminated copper ore. This concern set up a small generator driven by a gasoline engine and, placing electrodes in two of the drill holes, passed current through them in the attempt to extract the copper by electrolysis. I never heard any of the details, but I believe they are not now operating, whence I conclude the attempt was not successful.

The same gentleman who suggested the foregoing, had an ingenious scheme for transporting copper metal, in connection with a mine in Peru, which was without railway connection. His suggestion was that, after the copper was reduced at the mine, it be drawn into wire, one end of the wire to be carried to the coast and attached to a powerful winding engine by which the copper, continuously drawn into wire at the mine, would be dragged over the country and delivered at the coast.

Sidney J. Jennings.—The proposal of Professor Kemp to recover metal in ores without mining refers to a possibility which has always possessed an interest for me. One of our members, R. M. Catlin, made a statement some years ago concerning experiments he made on dissolving silver ore in place with a hypo-

sulphite solution, and, owing to the nature of the case, a fair measure of commercial success was attained by him. On the Rand, some experiments were made to dissolve the gold in the upper levels of the deposit. H. S. Stark, who was responsible for the successful treatment of tailing piles in place, conceived the idea that it would be possible to treat the upper level of the low-grade main reef by the same process which had proved successful on the tailings dump. The upper portion of the main reef was a porous banket, having a clayey streak on the footwall. Experiments on a small scale proved that the banket was permeable to cyanide solution and it seemed possible that, while undoubtedly a large amount of cyanide solution would be lost, a certain amount would be saved, and whatever was saved would be clear gain, as the gold contents in the main reef would not pay for mining and milling. Experiments were continued for a length of time sufficient to prove that we would only lose the cyanide solution, and would not recover gold.

During the first years of the development of the deep levels on the Rand, many suggestions were made to obviate the necessity for sinking the deep shafts contemplated. One enthusiastic French engineer came out to see me one day on the Crown Deep, and noticing the elaborate preparations being made for deep shafts and large mills, earnestly declaimed against the waste of capital when, according to him, all that was necessary was to sink a diamond-drill hole at the top of the property, and another one at the bottom, to pour cyanide solution in the top drill and pump it out, enriched with all the gold, from the bottom, precipitating this gold on zinc. His enthusiastic "Why not, Mr. Jennings?" still echoes in my ears.

J. Parke Channing.—Extracting metal from ores without mining them is not altogether an iridescent dream. The late John Stanton told me that about 1858, when he was at Ducktown, Tenn., among the properties under his management was the Eureka mine. This is one of the largest pyritic deposits in the district, but is low in copper, running probably less than 1 per cent. The result was that the black-copper zone under the gossan was so thin that it did not pay to drift it out. Mr. Stanton told me that he permitted the mine to fill up with water each month, and then would pump it out, running the water through boxes containing scrap iron, and that the results were a commercial success. I have been told that he was stopped in this work by the owners of the Isabella, an adjoining property, as they claimed he was, probably unconsciously, extracting the copper from their mine.

Allen H. Rogers.—It might be mentioned, also, that at the

Anaconda, in Butte, the mine waters richest in copper are drawn from those sections where the mines are on fire. The condition, although inadvertent on the part of the management, is evidently the same as that sought by Mr. Stanton.

T. T. Read.—Mr. Rogers' remarks and his comments on smelters remind me that Chile is the only country where I ever heard of smelting smoke being regarded as beneficial. The Societe des Mines de Cuivre de Catemou, east of Valparaiso, owns and operates ranches and vineyards, in order to keep down the cost of high living. The vines were attacked by the phylloxera and were about to die, when the smelter was blown in. It was then found that the sulphur dioxide served as an excellent disinfectant of the vines, which have flourished ever since. That is the only place I know where it is capable of proof that smelter smoke is a benefit to agriculture.

The President.—In his report as Secretary and Treasurer, Mr. Ingalls stated this afternoon the present position of the Society. As many of the members here were not present this afternoon, I think they would like to hear from Mr. Ingalls.

[Mr. Ingalls summarized the more important data given in his reports.]

The President.—Mr. Ingalls has referred in his remarks to the loyalty of members to the Society. I cannot allow the opportunity to pass without paying tribute to his loyalty and faithful service to the Society. It is only his loyalty and service that have made it possible to carry on the affairs of the Society with the efficiency and economy that have resulted in the very satisfactory financial condition shown by his report as Treasurer. I do not know that it is necessary formally to record a vote of thanks to him for these services, for he knows that we all appreciate his work during the years he has so faithfully served the Society.

[Mr. Riordan then proposed a rising vote of thanks as a tribute to the services Mr. Ingalls has rendered the Society, whereupon all the members rose in their places.]

If there be no further business, adjournment is in order. There being no further business, the meeting is adjourned.

W. R. Ingalls,
Secretary.

PRESIDENTIAL ADDRESS.

Association and Co-operation.

Assuming that the annual address of the President may properly deal with the intimate affairs and relations of the Society, I have selected subjects which concern matters of broader moment than the immediate activities and functions of the organization. I make this selection because I believe the past year has brought to the Society increased strength, greater influence, larger issues with which to deal, and a better and broader understanding of its place and work, and of the elemental forces that give it life and energy.

Professional instinct is the force that made the organization of this Society possible, that holds it to its work and binds its members together. This force has its origin in more deeply seated forces, and I believe we can gain a clearer perception of what the Society means, and what it can be expected to accomplish, by devoting some little time to an analysis of these forces in their relation to its past and future.

As men are judged not only by their deeds but also by the influence of their lives upon the communities in which they live, so, it seems to me, this Society will be judged not only by its work but also by its influence upon the profession which it serves; we therefore may give thought not only to the accomplishment of the objects for which it was organized, but also to the effect of ts influence upon the individual and the profession.

If we inquire into relations of the Society to the profession, I think we shall find evidence that it is exerting an important influence in directions which, perhaps, were not anticipated or fully appreciated by its founders. The direction in which this influence seems to promise the most valuable and far-reaching results is in cultivating and encouraging the growth of conditions that tend to promote professional solidarity.

The growing influence of the Society seems to be due not only to its work, but also to the fact that in outgrowing its infancy, it has developed individuality and character. The experiences through which it has passed during the six years of its life have shown that it has courage and tenacity, that its members are sincerely loyal to it and act with unity of purpose to carry on its work. These are traits of character which insure the adhesion of its members and increase the power and the sphere of its influence.

At the time of its organization, we did not fully realize what the Society might come to mean to its members. The chief object of its organizers was to secure for the profession an association which should be technically and professionally representa-

tive. Few, if any, of its charter members had a full conception of the many ways in which it might become useful and valuable to its members and to the profession at large. At that time some of us thought the Society should undertake the publication of a mining and metallurgical encyclopaedia, to be kept up to date by the issue of quarterly or annual numbers. This would have been a work worthy of its attention—one that this, or some other, organization should sooner or later assume—and was suggested early in the history of the Society because many of us feared that unless it performed some great work it might not show sufficient reason to justify its existence. We did not then realize how firmly its members were attached to it, how willing they were to work for it, how much they would value and enjoy its privileges and what benefits they would receive from it. Nor did we appreciate the influence of its existence and example upon the profession. As engineers accustomed to deal with tangible matter and measurable forces, we were perhaps inclined to estimate the value and strength of the organization solely by the work it was capable of doing.

But we have learned that the value of the Society depends in part upon its work, in part upon its influence, and in part upon the function it performs in satisfying the instinct for association, an instinct which is born in man as a craving not to be denied. Because we must attribute to association and co-operation all that has been achieved in the past, including the organization and growth of the Society, and also all that it may accomplish in the future, I have selected these words as the title of this address.

That eminent philosopher and author of classic writings on political and social science, Henry C. Carey, enunciated as a theorem of his philosophy, "the greatest need of man is that of association with his fellow-men." Perhaps with logic equally good we may say of the engineer, as Carey said of man, that "his greatest need is that of association with his fellow-engineers."

The value of association in its relation to the engineer would seem to be predicated upon the same facts and governed by the same laws that determine its value to individual man. Without association and co-operation, man's supremacy, safety, prosperity, and ability to utilize his superior intelligence, would be lost, and he could exist only as an animal of low rank. He has developed and utilized his intelligence only by association with his fellows. All civilizations have been the result of association and co-operation between men of like races and of similar intelligences. The law also seems to apply to the units of which nations are composed, and to the integral parts of such units, the law being that the greatest need is that of association with those of like kind—with fellows.

In promoting such association, the Society is performing a function which is purely personal and social, and another which is technical and non-personal; yet these two functions seem to be peculiarly interdependent and inseparable, both acting to draw together in that close association necessary for efficient work those who are able to carry on the work of the organization.

These thoughts are not new. Many of our members have expressed a belief that the value of the Society depends largely upon the opportunity it affords for the personal association of those with similar interests and engaged in like work. We all find pleasure and profit in this feature of our meetings. We find it is good to know our fellows, to cement fellowship with friendship and to work together to advance the interests which we serve. While, as individuals, we thus profit by these privileges, we are also enabled to co-operate in carryng out the definite purposes for which the Society was organized.

Although the objects of the Society cannot be attained by an organization conducted as a club for social intercourse, these social functions nevertheless appear to be of inestimable value both to the individual and to the profession. By such association, by coming together for the interchange of experiences and opinions, all may gain and none may lose, all may be benefited, may be inspired with new ambitions and add to their stores of knowledge. While these privileges and benefits inure to the individual, I think we may be sure that their influence reacts to strengthen the Society, to broaden its sphere of influence and to promote the interests of the profession which it serves.

In some respects it would seem that we are duplicating the experiences of the masonic guilds of the Middle Ages, which were incorporated with governing rules of their own, and admitted to membership only those who had completed a probationary term of service. A mason of those days could not permanently settle in one place, but moved about, from place to place, seeking employment where some great castle or church was to be built. His greatest need was association with his fellow-masons, for by this only could he gain the experience of others, and learn the varying conditions of employment in different localities. A realization of the benefits of the association, thus brought home to the individual mason, led to the remodelling of these organizations until finally they were merged in an institution dealing solely with the social and human relations of life and aiming to realize the full benefits that come from the continued association of those who are actuated by like impulses and governed by similar motives. It is interesting to note that while centuries elapsed before the encouragement of association for its social and individual value was generally acknowledged as an important object

of those guilds, the value of this function was recognized at the earliest meetings of our Society.

Perhaps the chief value of association in its relation to the advancement of professional interests is that it tends to develop professional solidarity. Professional solidarity implies power, influence, and the ability effectively to direct and apply a force which represents the sum of the forces of the individual units. Our time will not permit us to enlarge upon what this may mean to our Society or to the profession at large. The subject is one big with possibilities which cannot yet be accurately or clearly defined, but it does not seem premature to say that professional solidarity has developed rapidly within the Society, nor to predict that the force thus made available, acting in unison with like forces emanating from other engineering organizations, will bring results that cannot otherwise be attained.

The influence of the Society can best be increased by additions to its membership from among those who are interested in its work and appreciate its privileges. That its members should be qualified to assist in carrying on its work was recognized as essential from the outset, but, proceeding on the assumption that all educated men are self educated men, the Society has not limited its membership to those who have studied at technical schools or institutions of learning. In interpreting the qualifications for membership, the Council has considered experience, intellect, character, and achievement as the tests by which the fitness of any candidate should be decided.

In closing this address, I believe I am voicing the sentiments of its officers and councillors in adding an expression of appreciation for the cordial co-operation and support by which the members, and local sections, have approved and upheld the administrative acts and measures of the past year, and to say for them that nothing could so fully have compensated them for their services as these evidences of confidence in their management of the affairs with which they have been entrusted.

REPORT OF THE SECRETARY.

Membership.—The membership of the Society experienced only a small growth during 1913, the net gain for the year having been only three, against a gain of five in 1912, 42 in 1911 and 24 in 1910. Three members were lost during 1913 by death and three by resignation. The record of the year is summarized in the following table:

Total membership, Jan. 1, 1913	234
Members elected during 1913	10
Died	3
Resigned	3
Dropped for non-payment of dues	1
Gained in the year	3
Total membership, Jan. 1, 1914	237
Candidates before the Society on List No. 38	4
Candidates before the council on ballots Nos. 36 and 37	6
Applications pending	6

While the actual gain in membership has been small, it is to be remarked that during the last quarter there was a noteworthy increase in the number of applications, and at the end of the year 16 were pending, compared with only 3 pending at the end of 1912. The Mining and Metallurgical Society can not expect a large membership. Its growth up to this time has been perfectly natural; i.e., there has never been any organized effort to bring in new members and most members have come in upon their own initiative. It is, however, desirable to increase our membership, without sacrificing anything in the way of quality, and members are urged individually to take steps to bring in more members.

The applications for membership received during 1913 were carefully scrutinized by the executive committee of the council, and after submission of the reports of applicants, passed by the executive committee, to the entire membership of the Society for consideration, the names went before the council for letter-ballot, in conformity with the by-law governing election of members.

As a result of the careful scrutiny by the executive committee, no applicant was rejected on letter-ballot during 1913.

The members of the Society who died during 1913 were: F. T. Havard, G. W. Maynard and M. B. Patch. An obituary notice in each case was published in the bulletin of the Society.

Meetings of Sections.—The New York section held eight meetings, the San Francisco section, two meetings, and the Philadelphia section, one meeting during 1913. There were two meetings of the Society, viz., the annual meeting in January and a special meeting in February to act upon amendments to the

by-laws. We had, therefore, a total of 13 meetings during the year. The general meeting of the Society was devoted to business.

The New York section discussed the report of the committee on mining law, but in the main the discussions of the meetings of the sections in 1913 related to questions of technical practice. These discussions were interesting and valuable. We experienced some difficulty, however, in obtaining adequate reports of them for publication in our bulletin.

Committees.—The report of the committee on the award of the annual medal made in 1912, having been adopted by the council in 1912, was adopted by the Society on letter-ballot in 1913. The committee on mining law made a formal report during 1913. This report was discussed by the New York section. It is now before the council awaiting the action thereof previous to its submission to the membership of the Society. Two new committees were constituted by the council during 1913, viz., a committee on "mine taxation," of which J. R. Finlay was appointed chairman, and a committee on the "welfare of mine and metallurgical employees," of which J. Parke Channing was appointed chairman. Some minutes of the committee on standardization were published in the bulletin during 1913. The committee on welfare of mine and metallurgical employees reported progress. No reports were made by the other committees of the Society.

M. M. S. A. and A. I. M. E.—The status of the plan of union of the M. M. S. A. and A. I. M. E. up to the time of our last annual meeting was reviewed in my last report. At that time it was reported that the report of the joint committee had been adopted by the council of the Society but we had not been advised respecting action by the Institute. On Jan. 18 the secretary of the A. I. M. E. was informed that the council of the M. M. S. A. at a meeting on Jan. 14 had approved the plan. The secretary of the A. I. M. E. informed us under date of Jan. 30 that at a meeting of the board of directors on Jan. 23, 1913, the report of the joint committee was presented and was approved by a majority of the members of the board present. The plan of union was submitted to the membership of the Society and was adopted by letter-ballot on May 1, 1913, of which action the A. I. M. E. was notified. Under date of Aug. 27 a communication was received from the secretary of the Institute, stating that at a meeting of the board of directors at Butte, Mont., on Aug. 20, the directors of the Institute deemed the proposed union inexpedient.

Bulletin.—The monthly bulletin was published regularly

during 1913 and in general was published promptly on or about the last day of each month. The council adopted a set of rules governing the publication of the bulletin, and the bulletin has been published in conformity with these rules. The number of pages comprised in the 12 bulletins of 1913 was 324, compared with 194 pages in the 12 bulletins of 1912. The bulletin is printed under contract on terms that are reasonable. The composition and press work are not of the best but they are very good for the price that we pay. This matter was considered informally by the council during 1913 and it was decided to continue to do it as we have been doing.

Formal Actions.—In February the Society by letter-ballot adopted a set of resolutions recommending to Congress the provision of an adequate building at Washington for the U. S. Bureau of Mines and the U. S. Geological Survey; also a set of resolutions recommending the holding in abeyance of all proposed legislation affecting the patent system of the United States until such time as a commission shall have had ample opportunity to study and report upon that question. In May the Society by letter-ballot adopted the proposed plan of union with the A. I. M. E. It also adopted a series of oil land resolutions introduced by the San Francisco and New York sections and amended and adopted by the council. It also adopted amendments to by-laws No. 4 and No. 11, which had been passed at the meetings of the Society on Jan. 14 and Mar. 13. In June the set of rules governing the award of the annual medal was adopted by letter-ballot. All of these questions were referred to the whole membership of the Society. Our procedure in conducting such referenda has proved to be workable and sufficiently expeditious.

Annual Medal.—During 1913 the committee on the annual medal obtained designs for the medal, one of which was adopted by the Society. The committee then proceeded to arrange for the manufacture of the medal. Both in that and in the design, the committee had the benefit of the assistance of Tiffany & Co., and especially Dr. George F. Kunz. According to the rules for the award of the annual medal, nominations were made by the members of the Society and award of the medal was finally made by the council to Mr. Herbert C. Hoover and his wife, Lou Henry Hoover. The rules for the award of the medal, although put in operation for the first time were found to work satisfactorily.

W. R. INGALLS,
Secretary.

REPORT OF THE TREASURER.

The following report for 1913 is respectfully submitted:

The cash balance of the Society yielding only a moderate return as a deposit in the bank, by vote of the council, the Treasurer was authorized to subscribe for two $1,000 bonds of the general mortgage of the Chicago, Milwaukee & St. Paul Railway. The cost of these bonds was $1,990, plus $31.25 accrued interest. They yield us $90 per annum.

RECEIPTS.

Cash on hand, Jan. 1, 1913	$2,465.61
Petty cash on hand Jan. 1, 1913	3.05
Received for annual dues, 1911	10.00
Received for annual dues, 1912	70.00
Received for annual dues, 1913	2,135.00
Received for annual dues, 1914	10.00
Exchange	.53
Binding of Bulletins	163.50
Badges	75.00
Interest	84.92
H. S. Munroe (for printing)	10.75
Dinner, March, 1913**	25.80
W. R. Ingalls, personal	2.50
S. B. Christy, amount send for bound volumes	10.00
	$5,066.66

EXPENDITURES.

Printing Bulletins, lists, etc.	$ 762.38
Printing for H. S. Munroe	10.75
Salaries of assistants to secretary-treasurer	405.00
Stenography and typewriting	577.00
Postage, telegraphing and expressage	147.62
Stationery and office supplies	49.06
Section aid*	78.01
Badge (special order)	20.00
Binding bulletins	144.00
Bank exchange	6.01
Expense of meetings, including dinner**	44.60
Refund to S. B. Christy	10.00
General Expense	7.00
Expense connected with report of medal committee	8.00
Chicago, Milwaukee & St. Paul bonds	1,990.00
Interest on above	31.25
W. R. Ingalls, personal	2.50
Cash in bank and on hand, Jan. 1, 1914	768.82
Petty cash on hand	4.66
	$5,066.66

*N. Y. Section, $30.00; San Francisco Section, $48.01.

**Cost of dinner was $25.80, and was paid for by members who participated.

The assets and liabilities on Jan. 1, 1914, were as follows:

ASSETS:

Cash in bank and on hand, Jan. 1, 1914	$ 768.82
Petty cash on hand	4.66
Furniture and supplies	20.00
Bound volumes unsold	8.75
Dues payable	260.00*
Unsold badges	50.00
Chicago, Milwaukee & St. Paul bonds	1,990.00
Interest due on above	45.00
	$3,147.23

*For 1912, $40; for 1913, $220.

LIABILITIES:

Payments in advance for annual dues	$10.00
Payments in advance for bound volumes	72.00
Payment for life membership	50.00

Assets and liabilities in 1911, 1912 and 1913 were as follows:

	Assets	Liabilities	Difference
1911	$1,829.41	$ 72.50	$1,756.91
1912	2,754.91	148.00	2,606.91
1913	3,147.23	132.00	3,015.23

The treasurer's report for 1908 will be found on page 52, for 1909 on page 185 of the bulletin; for 1910 on page 7, of Bulletin No. 32; for 1911, on page 19 of Bulletin No. 44; and for 1912, on page 10 of Bulletin No. 56. Gross income and expenses for the last five years of the Society's existence compare as follows:

Income from dues	1909	1910	1911	1912	1913
and interest	$1,605.75	$1,880.49	$2,315.00	$2,347.99	$2,300.92
Total expenses	1,068.99	1,543.97	2,013.20	1,600.49	2,054.63
Excess of income	$ 536.76	$ 336.52	$ 301.80	$ 747.50	$ 255.29
Cash bal. on hand	1,045.26	1,381.78	1,744.41	2,468.66	773.48

In the operating expense for 1913, printing shows a large increase due to increase in matter printed. In 1912, bulletins aggregated 194 pages, and in 1913, 324, an increase of 128 pages. Additional matter was added to the list of members, etc., increasing it to 32 pages, as compared with 26 in 1912. Increase in postage, expressage, etc., is partly accounted for by the increase in weight of the bulletin.

W. R. INGALLS,
Treasurer.

MEETINGS OF SECTIONS.

NEW YORK.

A meeting of the New York section was held after an informal dinner at the Engineers' Club, on Thursday, Dec. 18, at 8.30 p. m. The meeting was called to order by the chairman, Mr. E. G. Spilsbury. Those present were: Sydney H. Ball, R. M. Catlin, J. Parke Channing, H. W. Du Bois, W. B. Devereux, Jr., E. L. Dufourcq, A. S. Dwight, H. C. Hoover, H. W. Hardinge, L. D. Huntoon, W. R. Ingalls, Sidney J. Jennings, H. H. Knox, S. Le Fevre, H. S. Munroe, R. Peele, W. A. Pomeroy, T. T. Read, W. L. Saunders, F. C. Smith, E. G. Spilsbury, G. C. Stone, S. W. Traylor, J. A. Van Mater, A. H. Wethey, H. A. J. Wilkins.

The Chairman.—Before we take up the subject which has been proposed for this evening's discussion, the Secretary has, I believe, a communication to present to us from the council, requesting us to rescind the action we took in relation to Mr. Winchell's report on the revision of the proposed mining law at one of our former meetings.

W. R. Ingalls.—For the council I report to the New York section that the council has rejected the resolutions and revision of the mining laws adopted by the New York section on Sept. 16, the reasons for the council's rejection being those stated by Mr. H. V. Winchell in his communication printed in bulletin No. 65, p. 286, to which the New York section is referred.

H. S. Munroe.—In the communication to which the Secretary refers, Mr. Winchell called attention to some points which were overlooked by the New York meeting, which, to my mind, are very strong and well worth considering. In view of this further communication from Mr. Winchell, and the changes which were proposed at that meeting, perhaps without the consideration which they should have had, certainly without the study which he has given them for many years, it seems to me right and proper that we should spend a few minutes in reconsidering that vote, and possibly in adopting without change, or with less radical changes, the resolutions that Mr. Winchell has submitted. To bring this matter to the attention of the meeting, and possibly to a vote, the chairman will perhaps permit taking a few minutes of your time to point out the changes that were made, and Mr. Winchell's objections to those changes.

If the gentlemen remember, Mr. Winchell suggested some ten recommendations, which he desired to have adopted by the Society. The New York section amended these in a radical way,

and Mr. Winchell objected to those amendments. In order to meet Mr. Winchell's objections, I will move that the action of the New York section in changing the verbiage of recommendation No. 2 be now reconsidered.

W. R. Ingalls.—This is wholly a matter of procedure under our rules. A committee of the Society has made a report to the council. Before the council had taken any action on that report, the New York section took action, which action was premature, the council not having had any opportunity to consider the matter. Under the rules, the council is obliged either to put the resolutions of the New York section to a vote of the Society, or else reject those resolutions; and this section has the opportunity either to accept the rejection or to reiterate the resolutions, in which case the council is required to put the matter to a vote. If the section insists upon such a vote, the council must put the question. If, however, the section does not insist upon such a vote, the council will be able to give consideration to the report of the committee, and eventually put it before the Society.

J. Parke Channing.—I think, in the circumstances, we had better rescind our action and wait until the report as a whole comes up before the Society, when we can present our objections again, and thus facilitate matters. I, therefore, make this motion.

(The motion, duly seconded, was carried.)

The Chairman.—We will now take up this evening's subject, "The One-Man Drill." I feel that this subject is one of very great importance at the present time, not only because of the great economies which its adoption has apparently brought about, but, also, because of the apparent disturbance which the introduction of this drill has injected into the labor question of the day, together with its effects on the health of the men operating it. There is no question that the hammer drill has come to stay, and it will therefore be to our advantage to study carefully its economies as against the increased dangers to which its introduction may have exposed the miner.

R. M. Catlin.—The hammer drill has changed a good deal, and is still changing. My knowledge of it is limited; that is to say, I thought I knew a good deal about it, a few years ago—more than I do now. It is an extensive field for experiment. Each advance reveals a new horizon, and I begin to think that there is much about the subject which no one can find out. It is hardly fair for others to generalize from the results we have obtained under the conditions at our mines, inasmuch as these are undoubtedly different from those at other mines. We attempted to

determine for ourselves the drill best suited to our work, regardless of what it might do under other conditions. To that end we set up a displacement meter for accurately measuring the air, at a place where we had ground of uniform hardness, so that the holes might be comparable. In order to compare efficiencies, we adopted a system of fractions, the numerators of which were the inches drilled per minute, and the denominators, the number of cubic feet of free air used per inch of hole. This fraction, written as a decimal, we call the "drilling factor." Of course, if you increase the drilling speed or diminish the amount of air used, the value of your drilling factor is increased proportionately. Among our first trials we obtained a factor of 0.043, while from later results we get 2.246, that is, 43 as against 2246. Those were the results of successive steps, and on that road we met many surprises. Some results were so surprising that we began to suspect other reasons for the differences than those appearing on the surface, as they were not attributable to the rock.

The following is taken from some of our observations, made on the same drill, at the same place, with the same air pressure, and the same form and size of bit. In one instance we got a factor of 0.218, and in the next trial, 0.354. In the first test, the condition of the bit was found to be excellent, but with the 0.354 factor, one of the wings of the bit was broken, and the other three were dull. Of course, that does not prove that one should break the wings off a bit to attain the fastest drilling. In another test, the average factor on three runs with the same machine was 1.410. We then changed the bit, and made another run with the same machine under the same conditions, and obtained a factor of 2.280. On taking out the bit it was found to be soft and not at all in first-class condition; but that does not prove that you should always use a soft bit.

On striking a piece of steel on its end, I can imagine that it takes an appreciable time for the impulse to travel the length of the bar, to the farther end, and return. If at that instant you hit it another blow, you are doing work on the end of the drill instead of at the point; but if you can synchronize the blows so that they strike when the cutting edge is against the rock, you ought to do more work.

Another observation leads to the same supposition. The drills break, sometimes, in three pieces, and frequently a bit is found so hot in one place that it will burn the hand, while in the center, perhaps, it is cool, indicating nodes where these vibrations conflict. Possibly that may be the cause of the breaking of the steel. I can not understand how any stresses can occur at these places of sufficient strength to break a drill into three pieces, unless they are caused by something other than the direct blow

on the end. This theory is not proved, and is as yet a mere supposition. I attempted follow up the theory a little further, and constructed a crude scleroscope, the idea being that with an inferior machine, but with properly selected bits and steel, one might do much better work than with a superior machine, using steel having a different vibration capacity. We did not go very far into that investigation because there are so many variables which can affect the result.

The Chairman.—Before taking up a discussion of Mr. Catlin's remarks I think it would save time, and be more satisfactory, if we should listen to the other gentlemen who will speak on the subject, and then discuss all of their remarks together. I will therefore now ask Mr. Devereux to give us his experience.

W. B. Devereux, Jr.—In mining operations, the cost of breaking ore must receive serious consideration, and a decision as to what type of drill to adopt, under conditions which permit the use of either hammer drill or piston drill, should be based largely on observation as to which drill will do the work the more cheaply.

During the past two years, the Mines Management Co., with which I am connected, has had charge of the operation of the Washington mine, at Oxford Furnace, and the Mt. Hope mine, at Mt. Hope, N. J. In the Washington mine, the ore is stoped by the underhand method, a 3¼-in. piston machine being used, and all holes drilled are "down" holes. At the Mt. Hope mine, the shrinkage system of stoping has been adopted. The holes are all "up" holes, and drilling is done with a 1¾-in. hammer drill. The ore in both mines is magnetite occurring between walls of gneiss. At the Washington mine, the vein is from 15 to 40 ft. wide, averages about 57 per cent. in metallic iron and dips at an angle of 55 deg. The ore contains about 3 per cent of sulphur, in the form of iron pyrites. At the Mt. Hope mine, the different orebodies vary from 6 to 20 ft. wide, the dip is about 70 deg., and the ore contains no pyrites, the percentage of metallic iron varying from 35 to 55 per cent. The Washington mine ore is harder than the Mt. Hope ore, but I consider that this greater hardness is offset by the tendency of holes at Mt. Hope to fiture. In both mines the ore breaks badly.

Taking everything into consideration, drilling conditions at the two mines are about equal. The class of labor, the wages, and the hours of work at the properties are alike. An objection may be raised that the operations of the two classes of drills are being compared under different methods of stoping, but I believe, as I will show later, that such objection is not justified, since the

cost per foot drilled does not depend to any great extent on the method of stoping.

The costs of drilling operations for stoping during the year 1912 were as follows, in cents per ton of ore:

	Washington Mine (Piston Drills)	Mt. Hope Mine (Hammer Drills)
Drilling	22.5c.	15.3c.
Repairs	1.4	2.4
Miscellaneous	2.4	1.2
Sharpening	1.5	1.9
Power	8.5	7.8
	36.3c.	28.6c.

Included in "drilling" are charges for steel, air hose, air pipe, etc. During 1912 the number of feet per drill-shift at the Washington mine was 23.7, and 24.5 tons of ore were broken per drill-shift. During the same period, at the Mt. Hope mine the number of feet per drill-shift amounted to 33.3 and the ore broken per drill-shift to 23.7 tons.

For the first eight months of 1913, the costs of drilling operations at the two mines were, per ton:

	Washington Mine (Piston Drills)	Mt. Hope Mine (Hammer Drills)
Drilling	21.3c.	14.6c.
Repairs	1.9	2.2
Miscellaneous	0.3	0.4
Sharpening	2.6	1.3
Power	3.8	5.4
	29.9c.	23.9c.

During this period, the feet per drill-shift at the Washington mine amounted to 24.5 and the ore per drill-shift to 25.8 tons. At the Mt. Hope mine, the feet per drill-shift amounted to 31.0, and the ore per drill-shift to 28.0 tons.

For the year 1912, the difference in cost for drilling operations was 7.7c. per ton in favor of the hammer drill; for 1913, the difference in the cost of drill operations is 6c. per ton in favor of the hammer drill. The decrease in the difference is due entirely to the fact that during 1913 the power cost at the Washington mine was greatly reduced through utilizing waste gases from the blast furnaces to generate power. This amounted to a decrease of 4.7c. per ton in power charges for drilling at that mine.

The average of the above drilling charges per ton is 33.1c. at the Washington mine, and 25.7c. at the Mt. Hope mine. The average number of feet per drill-shift at the Washington mine was 24.1 and the average ore broken was 25.1 tons. At the Mt. Hope mine the average feet per drill-shift was 32.1, and the average ore broken, 25.8 tons.

Calculating from these figures the cost per foot of hole drilled, it is seen that it costs 35.4c. per foot at the Washington mine, and 20.65c. at the Mt. Hope mine, a difference of 14.75c. per foot in favor of the hammer drill.

These figures indicate that on a cost basis the hammer drill in these mines is more economical than the piston drill, and I believe that generally, where conditions permit overhand stoping, it will be found cheaper to use the hammer drill. I have known cases, however, notably the Melones mine in California, where, after a careful test of both drills, the hammer drill was discarded in favor of the piston. In the Melones mine, the orebody is wide (about 70 ft.) and the rock is hard to drill, but breaks easily. Holes up to 14 feet deep are drilled, and from 20 to 30 holes are put in before a round is fired. About two years ago, hammer drills were tried, but it was found that they could not drill the long holes at all, nor could they drill so fast as the piston drill.

The great advantage of the hammer drill over the piston drill is that only one man is required to operate it. A quicker set-up can be made, and the drill is easier to carry from one part of a mine to another. The disadvantages are generally considered to be: (1) the dust; (2) the necessity for the operator to rotate the drill by hand.

So far as dust is concerned, I believe this feature is generally exaggerated. Hammer drills have commonly been used for overhead holes, which it is impossible to wet unless some mechanical spray is used. This applies equally to the piston drill. I have run a piston drill in stopes where overhead holes were made exclusively, and have not noticed that there was less dust than when a hammer drill was used. I am not in a position to affirm whether the dust is injurious to the operator or not, but I do not remember hearing of an authentic case of silicosis or pulmonary trouble induced by using a hammer drill in this country. In such raises as have poor ventilation, the dust sometimes becomes very bad, and we have recently had to stop raises for this reason; but I do not believe that if we had continued them, with a piston drill, conditions would have been any better. The principal objections to the hammer drill on the part of the miner is that it takes jobs from too many men, and that it is too hard to rotate. The last complaint may possibly be eliminated in the future by the use of a self-rotating hammer drill.

We have recently been testing a drill of this type at the Mt. Hope mine. This drill is equipped with a rifle bar similar to that used in a piston drill, and is operated by means of the usual spring and pawls. The rifle bar rotates the hammer, the front head socket, and the socket nut in which the drill is placed. The drill is equipped with the usual telescope feed. The diameter of

the cylinder is 2 in. as against the 1¾ in. diameter of the ordinary hammer drill. The drill weighs 101 lb., which is 22 lb. heavier than the usual hammer drill. The average depth drilled per day by an ordinary miner amounted to 58.85 ft.; the average actual time the drill was in operation during the 8-hour shift was 3.7 hours, the remainder of the shift being consumed in making minor adjustments on the drill. The drilling rate per miunte was 3.3 in., and the average depth of hole was 6 ft. No special effort was made towards a good showing with this drill, and it was used in ordinary mining work. A non-rotating hammer drill operated in the same ground by an equally competent drill-runner averaged 42 ft. per drill-shift. With the self-rotating drill, it was found necessary to use a 16-point bit to start the hole, followed by a 6-point bit, instead of the usual 4-point. The difficulties experienced in using the drill were: (1) The difficulty in starting the hole. (2) The drill cannot be used in loose ground, as it strikes such a heavy blow that it shatters and jars down too much of the back. (3) The drill is too heavy, as at present constructed, and one man cannot operate it on other than vertical holes.

If this, or some other, type of rotating drill can be perfected, it should help to counteract the dislike felt by the individual miner for the hammer drill, as the principal objection is that rotating it is very hard work.

The one-man hammer drill is much more economical for overhand stoping, except in unusual cases, than the piston drill, and I think the majority of the criticism aimed at it is not well-founded, and that its real defects can undoubtedly be remedied.

The Chairman.—We have with us to-night, by invitation, Mr. LeFevre of the Port Henry iron mines. He has had a good deal of experience with hammer drills, and will undoubtedly have some interesting information to give us.

S. LeFevre.—We have used small drills to a limited extent in the mining of magnetic iron ore at the mines of Witherbee, Sherman & Co., Mineville, N. Y. So far, this has been largely in the line of experiment.

Several years ago we bought a couple of stopers and used them for raising. They did good work, but the dust and borings fell directly on the head and shoulders of the operator, and since, to rotate the drill, he could not stand in any other position, the drill was not popular.

The ore itself is hard drilling, but the rock is harder, and the hanging-wall is exceptionally hard. It is a fine grained, highly silicious gneiss. A 2¾ in. piston drill will not average over 20 ft. per shift in the hanging wall, as compared with 40 to 50 ft. in ore.

We have always tried to find a single drill which would be suitable for all classes of work, and then use that exclusively, to minimize the number of drill parts to be carried in stock. We are experimenting at present with two Leyners for drifting or headings, three Jackhamers for bench work, and four stopers for raises. If each does much better work in its particular field, we may abandon our search for an all-around drill.

Our chief difficulty thus far has been to procure steel which will stand up to the work of the light drills. Cruciform 1-in. steel does not seem to have enough metal to stand; we are going to try the 1¼-in. octagon. The Jackhamers, using round hollow steel with automatic rotation, break the drill shanks when the hole gets down 6 or 7 ft., and the borings do not come out freely.

I would like to ask whether, in the opinion of others, there seems to be any difficulty in getting enough powder into the bottom of a small hole to break the ground? Is it advisable to use a higher strength powder when using the one-man drill, or, if not, will it not require the drilling of more feet of holes per ton of ore broken; if so, will not this counterbalance quite largely the advantage of the one-man drill in having a greater speed?

In our regular operations with two men on a drill, after the drill is set up the helper is kept busy much of the time in carrying the drill steel to the blacksmith shop, and water to the drill. We have installed a Leyner drill sharpener in each mine, so that the steel need not be brought to the surface, but the workings are extensive enough to require the steel to be carried 1500 ft. in some cases, and up a couple hundred feet to another lever. In ore, using 2–,4–,6–, and 8-ft. steel, the drill runner ought to have three sets or 12 pieces of steel, and each would drill 4 ft.; but in rock a bit will not stand over 1 ft. of drilling, thus requiring twice as much steel and yielding about half as much drilling.

Under these conditions, the one-man drill would not reduce the number of men by one-half, on account of the number required to carry steel, but it would undoubtedly make considerable reduction, and we are anticipating hopefully that the one-man drill will soon be perfected so as to offer valuable help in reducing the costs of mining.

R. M. Catlin.—In reply to Mr. LeFevre's question as to getting the powder to the bottom of the hole, we have made extensive experiments with deep holes and large ones, as compared with small ones; we find our costs are much less with many small holes than with a few large ones, because with small holes we have much less block-holing to do. Therefore, we do not attempt to put down deep holes—16 ft. is about as far as we generally go in our quarry work.

S. Le Fevre.—We find it is better not to put our holes in rows, to avoid breaking large chunks. The ore is broken in small pieces much more readily by irregular placing of the holes. Even in the same mine, our ore is much harder to drill in some places than in others, the difference being so great that in one part a driller can break twice as much as in another.

The Chairman.—We have heard now from the users of the drill; it will be interesting to have the views of the manufacturers. We have with us this evening a gentleman who may be termed the creator as well as the manufacturer of the present type of hammer drill; I take pleasure in introducing Mr. W. L. Saunders, who will give us a few words on his side of the question.

W. L. Saunders.—In that classic work on coal mining by Andre, published a great many years ago, the statement is made that a successful rock drill must be simple in construction and strong in every part. The author then goes on to say that it must be as light in weight as is consistent with the second condition, that is, strength. This simple statement has been the basic rule governing the design and construction of rock drills for the past 35 years. There never has been any difficulty in designing a rock drill to be mounted upon a truck, for submarine work, for instance, where the question of weight is a secondary consideration. In mining work, however, lightness of weight and simplicity of construction are essential conditions to efficiency. The early designs were operated by steam or air at 40 or 50 lb. pressure. In those days a reasonable amount of work was all that was expected. Rock drills were usually run by several men, they were used only in difficult places, and the real problem of power and capacity, combined with light weight and simplicity, was not brought prominently forward for solution.

All of the early types of rock drills were piston drills; that is, the steel carrying the bit was rigidly clamped to the piston, the bit being practically an extension of the piston rod. This type of drill had many advantages. It was simple in construction, the only quick moving parts were the piston and the valve, and the churning action of the bit helped to clear the cuttings from the hole. In the course of time, mining men sought to introduce rock drills into all parts of the mine. Efforts were made to increase the output of the mine by extensive development work, by stoping, and, as the ore grew lean, economies were studied. The first tendency was to increase air pressure. It was found that a rock drill would do from 25 to 35 per cent. more work when running at 80 to 100 lb.; and as these increased pressures were applied, the machines themselves had to be made stronger and heavier, the mountings were made larger, the repairs became

greater. This condition led to an increase in the weight of the drill until it ran up to 300 or 400 lb., except in soft rocks, where lighter piston drills were used efficiently even at lower air pressures.

About 15 years ago engineers began to design a different type of rock drill, now known as the hammer drill. In a hammer drill the piston and the steel carrying the bit are separated, the bit being pressed upon the rock and the piston hitting it on the end as one drives a nail with a hammer. To do work with such a machine at once demonstrated the necessity for some means of clearing the cuttings from underneath the bit. As there was no churning action, the bit being merely rotated, it became necessary to blow these cuttings away; this was done at first by water, later by a combination of air and water, which was forced through a hole in the center of the steel. This type of drill, using air and water for discharging the cuttings, was patented and introduced by Mr. Leyner of Colorado, who has diligently, for a long period of years, clung to the idea of a hammer drill as against the piston type. Mr. Leyner demonstrated that in actual speed of drilling, especially in holes that were at or near the horizontal, this drill would increase the speed of drilling from 50 to 100 per cent. He also demonstrated that, with the hammer drill, high air pressures might readily be used without undue damage to the machine or the mountings. It is evident that, when using air at, say, 100 lb. pressure in a hammer drill, in which a piston weighing only 8 lb. is reciprocated, say, 1000 times a minutes, the jarring effect is considerably less than when air at the same pressure is used to pulsate a heavy piston carrying a steel, the whole weighing some 50 to 75 lb. The momentum of the moving parts in the latter drill was such that heavy cushions were required in the cylinder ends, thus causing oscillation, which acted upon the mountings in such a way as to make it difficult to hold the drill steadily during hard service.

Mr. Leyner's success in demonstrating the essential features of the hammer drill led to the rapid introduction of the stoper, which is a hammer drill without the air and water features, and without any mounting other than an air piston upon the tail end of the machine, for pressing it forward against the rock. The stoper is, of course, essentially a drill for up-hole work, where the cuttings fall out of their own weight, but the stoper illustrates in a very practical way the essential features of the hammer drill in that it gives us a very efficient machine of large capacity and of very light weight and great simplicity.

The modern type of hammer drill, which has been so largely introduced during the past two years and is known as the Leyner-Ingersoll, is a stoper which has been designed and built for all

classes of work in mines, and is not limited to up-holes only. In making it fit for universal service it became necessary first to introduce air and water into the hole to discharge the cuttings, and next to provide a system of automatic rotation for the bit. It further became necessary to build the machine of special material, employing steel and alloys of steel, treated by elaborate processes of annealing, and the whole combining superior workmanship and design. Such a machine weighs from 45 to 150 lb. It contains no heavy moving part; hence it is easy to mount. Most of these machines require no mounting at all, being simply held in the hand of the operator, as a pneumatic riveter is held. This type of machine is known as the Jackhamer. It is easier for a man to handle than a pneumatic riveter, because it is usually used for down-holes where the weight aids in steadying the machine. Where these Jackhamers are used for inclined or horizontal holes, they are made so light in weight as to be easily handled. Such machines weigh from 20 to 32 lb. only. The sinker, so called because it is a Jackhamer for shaft sinking, and foot-wall or bench work in mines, is used only for down-holes. Its weight is about 90 lb., and while it might be made lighter it has been found advantageous to add to the weight so as to hold the machine more steadily down to its work.

For tunnel driving, side stoping, lifting, drifting, and all classes of heavier work in mines, the Leyner-Ingersoll drill is advantageous. This machine, and all the others which have been enumerated, are hammer drills, the heaviest of which does not exceed 150 lb. in weight. None of these machines is provided with the usual chuck, comprising bolts and nuts, and requiring constant attention. On the contrary, the steel is held loosely in the front head bushing, just as one would hold a piece of steel in his left hand, the piston or hammer striking the top of the steel as one would strike with a hammer in his right hand while holding the steel in his left. The process is absolutely simple, the mountings are light, and the operator does not find it necessary to have a helper to break away a ragged edge of the rock so as to enable him to start a hole properly. With a piston drill, on attempting to start a hole on an inclined or irregular surface, unless a hammer and chisel are used to break away a level place for it, more time will be consumed in starting than in drilling with the first length of steel. With the hammer drill, the bit is simply pressed upon the surface of the rock, automatically rotated, while being struck on the end, and the hole is quickly started.

It is evident, therefore, that what is called the one-man drill is not an adaptation of the old type of machine, but a new design, based on entirely different principles, weighing less than half as

much, maintaining itself more easily in position, feeding its air and water through the steel automatically, and thus doing away with the helper who is used to throw a tin cup of water into the orifice of the hole. This drill represents distinct economic progress, since by its use the miner is able to handle lean ore at a profit, thus largely increasing the output of mines, and giving employment to more laborers.

That the hammer drill has won its way on merit is amply demonstrated by the records that it has made during the last two or three years in different parts of the United States. In the Lake Superior copper country, for instance, several hundred of these drills have been used over a period of more than a year. The results invariably show a higher drilling efficiency, a higher tonnage efficiency, and an increase in the workman's wages. The net increase in drilling efficiency, based on feet of hole drilled per shift, when comparing the piston with the Leyner type in the Lake Superior district is 90 per cent. and the net tonnage increase per shift is about 33 per cent.

The Chairman.—One point which has not been touched upon very much tonight, except by Mr. Catlin, is the danger involved in the large amount of dust produced by the use of the hammer drill. I will ask Professor Munroe to say a few words on that subject, of which, I believe, he has made considerable study.

H. S. Munroe.—The dust question is a large one, and I really think we should devote a whole evening to it. Tonight I will attempt to bring out a few of the salient points which have developed in the last ten years in South Africa, Australia and England.

As perhaps you know, after the Boer war, when the mine operators in South Africa attempted to reconstruct their forces they were horrified to find that a very large percentage of the English miners were dead from silicosis. That brought attention to the dust problem in a very dramatic way. Since that time, a number of commissions have been appointed to study the question. Some drastic legislation has been enacted in order to diminish the fatalities from dust; compensation laws have been passed for the benefit of sufferers from this disease. Up to April, 1913, something like $4,000,000 has been paid, mainly in compensating men who have contracted silicosis in the mines; this does not include money which has been spent by the mining companies for dust prevention. It is surprising to me, in view of the situation in South Africa, that so little attention has been given to this source of danger here. It is quite true, of course, that the dust in different mines is not equally dangerous. We know that coal miners find very little inconvenience from the large amount of

dust that they have to breathe. It does not seem to have so serious an effect as stone dust. The dust in many ore mines does not seem to produce silicosis to the same extent as in the South African mines. Each mine must be judged for itself.

There are, however, many mines in this country in which the dust is quite as dangerous as in South Africa, and in some few mines the conditions are possibly more dangerous than there. In view of the drastic legislation that has been necessary in South Africa, and the very large amount of money that has been spent in compensating sufferers, it seems to me a question that is pressing upon us, both from a humane and from a business standpoint. We can not afford to sacrifice lives unnecessarily, nor to put ourselves in the position of having to pay such enormous sums of money to compensate victims of this disease, if it be possible of prevention.

The study of silicosis in South Africa and elsewhere has established the fact that the disease is due to miscroscopic particles of dust. This dust is so fine as to remain suspended in the air for hours, and so fine that aspirators are of little or no use. Dust is produced underground in drilling dry holes, in handling dry ore, and in blasting. The recently enacted mine regulations in South Africa attempt to prevent the formation of dust, and to clear the air of dust when produced, by compelling the free use of water in drilling and to wet the ore for handling, and in the use of water sprays to moisten the air at the time of blasting, and afterward. Water is led from the surface in pipes, which are carried down the shafts and through the levels and into every working place, drifts, winzes, and stopes, so that hose can be attached and water used freely everywhere. In the shafts and levels, spraying devices are installed so as to settle the dust in the moving air currents.

Experience has shown that it is possible by such means to reduce the amount of dust in the air to negligible amounts, except when blasts are fired and for some time thereafter, during which period the miners may be compelled to breathe air containing dust in dangerous proportions. It is recognized in South Africa that the problem is not yet fully solved and that further legislation will be necessary.

A few figures will show the magnitude of the trouble. A report appeared about a year ago by a commission of seven physicians appointed by the Government. This report is of a statistical character and is based upon an examination of over 4000 men, of whom over 300 were submitted to special radiographic and bacteriological examination. The average age of the miners examined was 33 years and, on an average, they had worked about four years underground. Of the men examined, 32 per

cent. were found to be more or less affected with silicosis. Of the drill men, 48 per cent. were affected. The average life of a drill man, breathing dusty air, was about nine years before becoming incapacitated for work. His expectation of life after quitting work was from one to two years. The examination was confined to white miners, and it was estimated that out of the total number of 11,400 there were 3600 affected by silicosis at the time of the report. It was estimated by the commission, assuming a stable mining population of 12,000, that from 1000 to 1200 would be incapacitated by silicosis each year and that 90 per cent. of the miners would ultimately contract the disease.

The Chairman.—The subject is now open for general discussion. One point brought up by Mr. Catlin appeared to me very striking, namely, the peculiar fractures to which the hollow-steel drill, under the impact of the hammer, seemed to be subjected. These fractures do not appear to be due simply to the actual blow of the hammer but to an interior condition of abnormal strain in the structure of the steel itself. I think that possibly the trouble is due to the method under which these hollow drills are produced. The ingot is first punched and then forged down on a mandrel. Any defect, or ragged edge, on the punch originally used would cause striations along the interior surface of the hole and in the subsequent hammering down over the mandrel these lines would never be entirely obliterated. The grooves might be closed but would probably include a slight film of oxide in their folds which would still remain in the finished drill, and under the jar of operation would naturally become a source of weakness. This trouble would also be increased by the unequal annealing of the material during the time of its reduction, owing to the fact that surfaces exposed to the mandrels would be cooled more rapidly than the rest of the material and undue shrinkage strains would likely be set up. I believe that this is the direction to look for the cause of the rapid failures rather than to the quality of the steel of which the drills are made.

R. M. Catlin.—I had an idea that the breaking of the drills was due to the inequalities in the steel, but I have never seen a longitudinal fracture in a drill. These fractures of which I speak indicate a nucleus, and correlation indicates that the fracture has begun from this nucelus and spread outward. As is observed in a flaw in glass, these are concentric rings spreading out from a central point. It is as though there were in the nucleus some substance which has developed, under the strain of the vibrations or heat, a tendency to expand more than the elasticity of the steel could accommodate. This nucleus seems to run through the length of the steel, and if you break it anywhere you can expect

to find it. We have steel of all kinds and prices from 5c. to over 30c. per lb. As a matter of fact, the higher-priced steel does not seem to be the more durable. We have tried hollow drill steel having an absolutely round hole, with no better results, even though it was a drilled hole.

W. L. Saunders.—We have experimented a great deal on the subject of the round hole, and we have had to give it up. We thought that the mandrel might have a great deal to do with it, and went to great expense to bore a hole in a piece of the best quality of steel, but experienced the same trouble. The steel problem is being solved, not by American, but by foreign metallurgists, and the steel that is now standing up best under the hammer blow is of foreign make, with a hole in it. Referring again to the difference between a piston and a hammer drill, in the latter the bit is pressed against the bottom of the hole, and is of the blows are struck when the bit does not touch the bottom then struck a thousand blows a minute. Probably 10 per cent. of the hole, since you cannot press a piece of steel against the bottom of a hole and hit it with a hammer without the steel's bouncing back.

J. Parke Channing.—The subject announced for this evening seems to have changed to a discussion of the relative advantages of the piston drill and the hammer drill. I am free to say that I have been very well satisfied with the one-man piston drill. It perhaps cannot drill so many feet as the hammer drill, but it has a great many advantages, particularly the fact that it takes only one man to operate it. Mr. Gottsberger and I began to experiment with it about six years ago. At Miami, although we are very well satisfied with the hammer drill, our feeling now is that we are getting better results out of the light-weight one-man piston drill, and we certainly find that for drifting and ordinary stoping it is superior to the hammer drill, taking everything into consideration. We are using some hammer drills, and will probably use more, although we are rather chary of putting them in, simply on account of the dust. Maybe the ore we are working in is of a peculiar character, or is similar to a great many others in which the hammer drill fails to draw itself out of the hole. That is one advantage of the piston drill; it will clear itself, because on the return stroke it must pull out the bit. We should, therefore, not lose sight of the fact that a one-man drill does not of necessity have to be a hammer drill. We are inclined to think that if someone could invent a light-weight piston drill, retaining the advantage of the hollow steel and the injection of water into the hole, we should have a machine that could not be beaten. The Leyner machine is the nearest approach to that, although it

is a hammer drill. A further difficulty is to get an operator for the Leyner machine. It takes three or four months to train a man to take proper care of his water and air connections. Therefore, although the Leyner drill, when you find a good operator, does very good work, with the type of men we commonly have to employ, the light-weight piston drill, in our case, gives us the best results.

We should not lose sight of the fact that the light-weight piston drill is one that should be very seriously considered. Over 30 years ago, when I was a student under Professor Munroe, he told us that he believed the success of a great many of the narrow veins in Colorado would be solved by the use of a light-weight one-man drill, and it has taken 20 or 25 years for that to come about. At Miami, I might say, we could not work if we used a two-man drill, and yet our vein is not narrow, but a large one.

W. L. Saunders.—I am very glad, as a manufacturer, to hear what Mr. Channing has said. The company I represent would never have taken up hammer drills if they had not been forced to it by efficiency results. We had in stock, according to our last annual report, nearly $1,000,000 worth of piston drills and parts; we believe that about three-quarters of it will be lost. To my mind, it has been demonstrated that for general purposes (not for particular conditions such as exist in Mr. Channing's mines, of which he knows best) drilling in mines calls for a lighter weight machine than it is practicable to make of the piston type. We are able with the Leyner drill to secure just as effective work with a machine which weighs less than half as much as the piston type, and the records show that by actual experience the drilling accomplished is from 50 to 100 per cent. greater.

H. C. Hoover.—Regarding the dust question, I do not believe that problem arises in American mines, barring possibly the larger ones, as it does in South Africa. There it is due to the flatness of the stopes and their narrowness, the short holes, the nature of the shoveling that has to be done. The fact that the mines are saturated with tuberculosis bacteria is a great part of the problem. There the stopes necessarily must remain open, and after every blast the dust is set in circulation. The dust problem has not reached alarming proportions in this country so far, and it is not likely to reach anything like the crisis that it has in South Africa.

S. Le Fevre.—In regard to dust, with us we have not known of many cases in which miners have contracted tuberculosis as a result of dust in the mines. In our mills we have more dust than in the mines; yet men who have worked there for more than ten

years have not shown any signs of inconvenience.

I might say, in connection with the fracturing of steel, that I have heard of one mine in Sweden which has adopted the practice of annealing all steel once a week. Probably they found there that crystallization made it break, and annealing helped the matter.

R. M. Catlin.—In regard to this dust problem, so far as I understand it, the consensus of opinion does not recognize any connection between the miners' phthisis and tuberculosis. I was a member of a commission in South Africa, before which that fact was very fully brought out, and am firmly of the opinion that as surely as blood will flow from a cut finger, just so surely will miners' phthisis result from continued work in quartz dust. A portion of the lung of a patient who had died of this disease was brought before that commission. One of the surgeons showed a little vial which contained particles from the disintegration of a cubic inch of the lung, and under the microscope it was seen to be composed of little quartz particles about three diameters long and very sharp. The progress of the disease seems to be much the same as when one gets a thorn in the flesh; nature endeavors to throw it out, and, failing that, encysts or covers it up. So, in a lung, the little quartz particles cut in, nature attempts to eject them, and, failing this, encysts them, and the lung becomes solid, like liver. To demonstrate the matter further, the surgeon took a knife and tried to cut a piece of this tissue, when the knife became dulled. The lung showed absolutely no evidence, according to the surgeon, of any tubercular condition, and while tuberculosis may be concurrent with the silicosis condition, they seem to be entirely distinct diseases and not necessarily coincident. The testimony, up to the time I left, was that the majority of the deaths were not tubercular, but were due to silicosis.

H. S. Munroe.—In regard to the tuberculosis aspect of the dust question, of the miners examined, of whom 32 per cent. had silicosis, the proportion that had tubercular trouble was very small, because these were men still engaged in active work. The tubercular trouble is a late development of the disease, and comes from the exhausted vitality of the suffers from silicosis. Most of the men who died, weakened by silicosis, contracted some other disease that carried them off. A very large proportion died of tuberculosis superadded to the silicosis, and it is that which makes their expectation of life so short.

H. M. Chance.—The Philadelphia section of the Society held a meeting recently, at which some little discussion of this subject

took place, and the question of dust produced by the hammer drill was brought up. I do not think we should accuse the hammer drill of being the sole offender in the production of dust. The piston drill, in dry holes, will make dust in much the same manner as the hammer drill, though it does not drive it out on the operator in exactly the same way. This question of injury to an inhaler of dust, whether he be miner, or mucker, or driver, or trammer, has been thoroughly investigated in the past by various commissions. I do not recall where the most elaborate series of investigations were made, but I do remember distinctly that the conclusion reached has been that the injury depends entirely upon the nature of the dust. If the dust consists of splinters such as one gets from pulverizing glass or a glassy quartz, it has the maximum injurious effect; whereas, if the dust consists of finely rounded, smooth particles, such as is made by pulverizing coal, practically no damage is done by it, unless inhaled in enormous quantities. In the first case, actual penetration of the lung tissue by the sharp particles occurs, working their way into the interstitial portion of the lung tissues, and producing the disease generally called silicosis. We rarely see this disease in slate-working factories in which the slate is sawed and shaved by hand, even where the work is done dry, producing large quantities of dust. In coal mines, the dust, which is partly coal dust and partly soot from the miners' torches or lamps, may make the lungs very black, but frequently the men live and work for years and experience no ill effects from it. Another type of injury to the lungs and air passages may come from certain ores in which the dust contains some irritant or poisonous chemical, or may have condensed upon itself acids or alkalies. The dust referred to, which does the damage and produces silicosis, is usually quartz dust, or the dust of highly silicious minerals.

H. H. Knox.—I should like to ask whether any members have had experience with devices to catch dust as it is formed; what is the efficiency of such devices?

W. L. Saunders.—We have had a great deal of experience with all sorts of such devices. These devices will not be used by the men. One of the most important qualifications of a rock drill is simplicity. If you require a miner to use such a device, or put on a mask, he will take it off as soon as you leave. It has been found by long experience abroad that the only solution of the dust problem is the injection of water into the hole; that is being practiced very largely abroad, where the laws compel the adoption of means for that purpose. In some mines, sprays are used at the orifice of the hole. The two systems which have

survived after years of experience are the injection of water into the holes, and spraying against the orifices of the holes.

The drill that is used most largely in the Lake Superior country to-day is provided in every instance with a tube which carries air and water to the bottom of the hole, and so long as that is used, practically no dust escapes from the drill hole. This is not an experiment, but is a practical success in drilling, but, as Mr. Channing has intimated, it has been applied successfully only to the hammer drill.

R. M. Catlin.—I presume Mr. Saunders refers to the hole running through a hollow drill. I have witnessed experiments on the injection of water through a tube parallel to the axis of the drill; it seems that when a hole gets in about 5 ft., the jet is of very little benefit. The hollow steel, of course, seems to solve this problem.

In regard to the character of the dust at our mines, I may say that the gangue is limestone. Certain men now working there have been there for 30 years, and, though closely questioned, the old physicians in that locality say they have never known a case of silicosis or miners' phthisis to originate there. Some of our medical friends tell us that it is improbable that the juices of the body dissolve the dust. But it is a fact that we have traced it through the system and find the peculiar elements of our mineral (that is, manganese, calcium, zinc, and iron) in the excretions. It is not there as dust, and if the dust can not be dissolved by the juices of the body, it is not clear how the elements of the dust appear in the urine.

Sidney J. Jennings.—I served on a commission appointed to test some of the devices that were brought to the attention of the mining industry in South Africa, in response to the offer of a prize for anybody who could solve the problem of allaying dust. A large number, some 30 or 40, devices were suggested. The one that won the prize was a spray attached to the drill, which sprayed water by means of an air jet against the face of the hole. Devices for attachment to the hole, to prevent the dust from falling on to the driller, were not successful. Mr. Catlin has mentioned the device for spraying water parallel to the drill. The objection made by the miner to the spray that won the prize was that he would very much rather breathe the dust than be wet and get rheumatism; hence the device was introduced only with the utmost power of inspection, and it was not really a marked success while I was on the Rand. So far as my experience goes, the only promising means of laying dust is the hollow drill.

One feature which has not been mentioned is the fact that on

the Rand the atmosphere is charged with many gases which do not predominate in the mines of America. On the Rand they use a much larger quantity of powder per ton of ore, and thus develop a certain amount of nitrous oxide gases and carbon monoxide, as well as the dioxide. It was the idea of one set of physicians on the Rand that the mortality of the miners was due as much to the presence of these noxious gases as to the sharp particles of dust. Probably both causes are operative. The fact that at the present time they are introducing artificial ventilation in precious metal mines, which is probably the only place in the world where this is done, and that they are sinking circular shafts solely for the purpose of ventilation, shows that this feature of the problem is engaging the attention of the engineers on the Rand almost as much as the dangers of the dust itself.

Recently a very elaborate investigation has been taking place on the Rand on the subject of keeping drills in repair, and keeping tight the pipes and all hose connections. Compressed air is sold to the different mines from central stations. It is metered out, and the superintendents of the mines know that every month they must pay for the amount of air they use. This has led them to study all possible means of minimizing their losses, and in the first ten months of 1913 they have been able to reduce the losses from leakage by about 20 per cent. They find that in the matter of drill repairs, the most economical way of doing the work is to give the drill fitter, a machinist in charge of the drills, a contract, by which he is credited so much per drill, and if the actual value of the spare parts and labor and power used is less than that amount, he gets half the amount saved, in addition to his wages. By this means they have cut the cost of supplying drills with spare parts to about one-third of what it was before this system was adopted.

H. M. Chance.—I think the Society owes Mr. Saunders a vote of thanks for the very interesting and instructive talk he has given us this evening, and, with that in mind, I would like to tell what little I know about the Jackhamer drill; it may be a satisfaction to him to hear it. In the latter part of October, 1913, I put a Jackhamer drill at work against a piston tripod drill, both taking air from the same manifold and working in the same rock, side by side, under precisely the same conditions, in sinking a shaft. We had very low air pressure, about 65 lb. We kept a record of the work done by the two drills during the month of November, and at the end of the month we found that the little Jackhamer had done about two-thirds of the total work accomplished in the month, or twice as much as the two-man drill. The rock in which the work was done is a hard granite gneiss.

G. S. Rice.—Ever since the Bureau of Mines was organized, its officials have been anxious to take up an investigation of the rock-dust problem, but lack of funds has not permitted it except in a very small way.

Dr. Hotchkiss, who jointly represented the Bureau and the Marine Health and Hospital Service, found that there are a great many cases of miners' phthisis or silicosis in the Western quartz mines, especially in those having a hard, flinty, gangue rock; he also found great difficulties in tracing out records of affected miners, because the men shifted from place to place. The usual history seemed to be that men who were too seriously affected to continue working in the mines would go off ranching, perhaps, and generally died at points distant from the mining districts where the disease was contracted. Unfortunately, Dr. Hotchkiss died and his records were lost. The Bureau had a physician last summer make a brief visit to Western mines, and he also found many cases of miners' phthisis in the Butte district, and other Western camps.

The Bureau hopes to take up this work systematically in the near future and already a number of samples have been taken by it, particularly by one mining engineer, who has been working on the metal-mine ventilation problem. We wish systematically to sample the rock dust floating in the air and to follow up the cases to learn to what extent the miners are affected with different degrees of exposure. Apparently the quartz mines give the most trouble. The method of sampling we use is a modification of the one suggested by Dr. Haldane, of England. It consists in taking an automobile tire pump, fitting it up and calibrating it, then pumping in the air through dried and weighed cotton in a glass receptacle placed at the end of a rubber tube. The rock dust is caught by the cotton, which, on being received at the laboratory in its glass receptacle, is again dried and weighed. The pump having a definite displacement, the amount of dust per unit of space can be figured. The idea is to take samples at the point where the driller or mucker will breathe when working normally; in other words, the intake of the dust sampler will be held at a point where his nose and mouth would normally be. It will give at least an approximation of the relative exposure. We have used this method to determine the density of coal dust in the air in explosion galleries, with results favorable to the method. With reference to coal dust, our observation has been, like that of others, that coal dust does not seem to cause consumption or injure miners. In fact, coal miners seem to have a rather lower death rate from consumption than men in many other industries.

The question of harmful gases in metal mines is something that the Bureau is now investigating. We have had two mining

engineers investigating it, one in the iron and copper district, and one in the far West. We have not yet enough data to draw conclusions, but I was very much interested, the other day, in receiving samples from a mine in Nevada, where, four hours after blasting, there was 0.03 per cent. of carbon monoxide in the air. For men to be exposed daily to such an amount is serious, for, as well known, the effect of monoxide on the human system is cumulative, though some persons appear more resistant to its effects than others.

The Chairman.—This is rather an epoch-making evening for the New York section. It has been suggested, to avoid a strain on our members through attendance on the monthly meetings of our Society in addition to the frequent gatherings of the Institute section, that joint meetings might be held. A beginning of that idea is clearly seen in this evening's meeting. I hope that this is the first break in the differentiation between the two societies, and that in future the meetings can be held as joint meetings, if possible; or, if not exactly as joint meetings, that at least all members of the Institute who are around will feel at liberty to come in and join us at any time. I am sure we are all delighted to have the worthy president of the American Institute of Mining Engineers here with us tonight.

C. F. Rand.—We feel very much indebted to Mr. Spilsbury for the invitation to join you here and for the opportunity to listen to the discussion.

In an adjoining room we have just held the first meeting of one of the additional technical committees of the American Institute of Mining Engineers, the committee having in charge the interests of the Institute in the technology of coal and coke. As Dr. Chance, the president of your Society, is chairman of this important committee, the friendly relations existing between the Society and the Institute are again emphasized.

In much of the work which the Institute has done during the last year we have found it most profitable to follow examples set for us by your Society, and I have no doubt that the high standards the Society has set have had an important influence on the activities and welfare of the Institute.

(On motion, the meeting adjourned at 11 P. M.).

L. D. Huntoon,
Secretary of Section.

Mining and Metallurgical Society *of* America

Vol. VII. February 28, 1914. No. 2

ANNOUNCEMENTS

New York Section.—A meeting of the New York section will be held at the Engineers' Club, New York, on Thursday, Mar. 19, 1914, at 8 p.m., preceded by an informal dinner at 6:30 p.m.

Bound Volumes.—Bound volumes of the bulletins published during 1913, including index, will soon be ready for distribution, and may be obtained from the Secretary at $1.50 a copy. Any member desiring a complete set of the bulletins for 1913, unbound, may obtain it without charge.

Annual Dues.—The annual dues of $10 are now owed. Members are requested to make their checks payable to the "Mining and Metallurgical Society of America." Members who desire the bound volumes of the bulletins for 1914 are requested to remit $1.50 extra. Bound volumes for 1914 will not, of course, be available until after the end of the current year, but it is desirable to know in advance how many will be wanted.

Erratum.—By one of those absurd typographical errors that are overlooked, as sometimes happens, the title of Mr. A. H. Rogers' talk at the annual meeting of the Society was given in the last bulletin as "Mining Conditions in South Africa," when, of course, "Mining Conditions in South America" was intended.

Committees.—The President of the Society has appointed Messrs. D. M. Riordan and L. D. Huntoon, members of the committee to arrange the dinner of the Society to Mr. and Mrs. Hoover, on Mar. 9. Mr. E. G. Spilsbury, chairman of the committee, had previously been appointed.

Annual Medal.—The dinner of the Society, at which the medal will be presented to Mr. and Mrs. H. C. Hoover, will be at the Hotel Biltmore, New York, on Mar. 9. Ladies have been invited, and members may bring guests. An invitation was extended to the members of the American Institute of Mining Engineers to participate in this dinner upon the same terms as members of the Society.

Election of Members.—In response to an inquiry respecting the method of electing members of the Society the following was communicated and is here reprinted as being perhaps of general interest:

(1) A candidate makes application and refers to three members. Inquiry is made of those members. If they *endorse* him, the application papers are called "complete." (Endorsement instead of mere reference was an innovation introduced about a year ago.)

(2) When an application is completed, all the papers are sent to the five members of the executive committee. If they approve unanimously, the name of the candidate is immediately put before the members of the Society. If only a majority of the committee approves, the case is delayed until the next meeting of the committee and action is then taken after discussion.

(3) The name of a candidate approved by the committee is submitted to members of the Society and remains before them for 30 days. At the end of that time if no objection has been received the name goes on a ballot and is sent to the councillors. The ballot is canvassed when all the councillors have voted, but it is canvassed at the end of 30 days whether all have voted or not.

(4) If objection to any candidate has been received, during the 30 days while his name was before the members, the case is delayed until the next meeting of the executive committee, when the objection is considered and the case is decided, or deferred pending further consideration.

W. R. INGALLS,
Secretary.

MEETINGS OF COUNCIL

A meeting of the council of the Mining and Metallurgical Society, called by the President, for which, because of reasons of weight, as declared by the President, the statutory 10 days' notice was not given, was held at the Engineers' Club, New York, on Monday, Feb. 9, at 5 p. m.

President Kemp presided. The members present were Messrs. Kemp, Channing, Munroe, Stone and Ingalls, a total of five, this constituting a quorum. E. G. Spilsbury, chairman of the dinner committee, was present by invitation.

Mr. Spilsbury reported that he had heard from Mr. H. C. Hoover, who would be in New York between Mar. 4 and Mar. 11, and at any time between those dates he and Mrs. Hoover

would be at the disposal of the Society for the presentation of the Society's medal to them. Mr. Spilsbury further stated that Monday, Mar. 9, would be the best date for this function.

Upon motion, duly seconded and unanimously carried, it was voted that the presentation dinner to Mr. and Mrs. Hoover should be in New York on Monday, Mar. 9; that the price of the dinner should be $5 per person, without wine; and that an invitation be extended to members of the American Institute of Mining Engineers to participate in this dinner and presentation upon the same terms as the members of the Mining and Metallurgical Society.

Upon motion, duly seconded and unanimously carried, the President, Vice-President and Secretary of the Society, together with Messrs. Channing and Munroe were elected executive committee of the council for 1914.

A meeting of the council was held at the Engineers' Club, New York, on Monday, Feb. 16, at 5 p. m. The members present were Messrs. Garrison, Ingalls, Kemp, Munroe and Stone, a total number of five, this constituting a quorum. Mr. E. G. Spilsbury, chairman of the dinner committee was present by invitation. President Kemp presided.

The Secretary reported receipt of a communication from the secretary of the Canadian Mining Institute, inviting the Mining and Metallurgical Society to be represented by delegates at the annual meeting of the Canadian Mining Institute in Montreal on Mar. 4, 1914; also a communication from the secretary of the Canadian Mining Institute suggesting co-operation in the work of standardizing practice.

The Secretary reported receipt of a communication from Philip Argall, member of the council, reporting intention of taking steps to organize a local section of the Society in Denver, Colo.

Upon motion, duly seconded, it was voted unanimously that the Society underwrite the expense of the dinner on Mar. 9 to the extent of $500.

Upon motion, duly seconded, it was voted unanimously that forms of statement and ballot with respect to the resolutions on amendment of the mining laws, ordered at a previous meeting of the council to ballot of the members of the Society, be approved as submitted by the Secretary.

A member called attention to his belief that the provision in by-law 13 of the Society that "five councillors, present in person or by proxy, shall constitute a quorum" is contrary to the law of the state of New York, under which the Society is incorporated, said law forbidding representation by proxy at meetings

of boards of directors, to which the council of the Society is equivalent. The Secretary stated that within a short time, the constitution and by-laws of the Society had been submitted to counsel, who reported that they were legal. In further discussion it was suggested that the matter of representation by proxy might have been overlooked.

Upon motion, duly seconded, and unanimously carried, the Secretary was instructed to consult with counsel respecting the matter of representation by proxy in council meetings.

A communication from the Canadian Mining Institute suggesting co-operation in the study of standardization of practice was discussed. The Secretary said that he had received several communications on this matter from the Canadian Mining Institute during the last six months and that it had previously been discussed by the council of the Society, which, however, had taken no action. The Secretary read as follows from a letter by him to the secretary of the Canadian Mining Institute under date of Jan. 20, 1914:

> Our standardization committee has not made any report. Some of its minutes or memoranda have been published in our bulletin, but nothing more. Nor has any broad scheme of study been laid out. At a meeting of our council not long ago it was suggested that the I. M. M., C. M. I. and the M. M. S. A., which are interested in this subject, might each appoint committees, which committees could correspond among each other and lay out plans of study, the reports of these committees being exchanged among the three societies and adopted by each if they saw fit; even if they were adopted with amendments to suit particular conditions there would be something gained in the direction of uniformity. This was offered merely as a suggestion, and no action was taken upon it.

Upon motion, duly seconded, and unanimously carried, the Secretary was instructed to communicate to the Canadian Mining Institute the willingness of the Society to co-operate with it in this matter and to suggest the plan outlined in his letter of Jan. 20, 1914.

Upon motion, duly seconded, it was voted that the President be authorized to appoint three delegates of the Society to the meeting of the Canadian Mining Institute in Montreal on Mar. 4.

E. G. Spilsbury, in behalf of the dinner committe, reported that the committee considered that the most satisfactory arrangements for the dinner on Mar. 9 could be made at the Biltmore Hotel, and reported progress in the arrangements otherwise. Upon motion, duly seconded, it was voted unanimously that the dinner of the Society on Mar. 9, 1914, be at the Biltmore Hotel and that the dinner committee be authorized to make all further arrangements for that dinner, with power.

W. R. INGALLS,
Secretary.

MEETINGS OF SECTIONS.

PHILADELPHIA.

The Philadelphia section held a meeting at the Union League Club, Dec. 15, 1913, preceded by a dinner at 6:30 p.m. This was the first meeting of the section since April 4, 1912. Those present: Messrs. Sanders (chairman), Chance, Conner, DuBois, Fairchild, Hutchinson, Penrose, Garrison.

The Secretary reported a sufficient balance of funds in his hands to meet all probable expenses for postage, typewriting, etc., during the ensuing year. He also noted the fact that since its last meeting the section had lost one of its most distinguished members, in the death of William A. Lathrop, on April 12, 1912, and that proper reference to this said event had been duly made in bulletin No. 47 of the Society.

Miners' Phthisis.

H. M. Chance, in the course of an informal discussion upon rock drills, spoke of the troubles from fine dust entailed by the newer forms of such machines, and referred to past investigations on the effect of coal dust upon the health of miners, published by the Second Pennsylvania Geological Survey about 1882.

He stated that the fine dust resulting from mining operations, and from industrial pursuits, seemed to affect the lungs and air passages in three ways: (1) When the rock is chiefly of quartz, or silicious material, the dust consists of angular particles or splinters with sharp cutting edges, which particles work through the mucus membrane into the lung tissue, causing serious lesions or death. Such conditions are well illustrated in the South African gold mines, and in some of the mines in the western United States, wherever the gangue of ores consists of amorphous quartz, which breaks with a sharp conchoidal fracture. (2) Other entirely distinct pulmonary and bronchial diseases may be caused by dust or soot which carries irritating or poisonous acids or oils condensed upon the surface of the particles. These substances, while not necessarily fatal in their effects, are likely to render the individual more liable to contract tuberculosis, or other disease, by weakening the tone of the tissues. (3) Another effect caused by the inhalation of very large quantities of dust is the overloading of the lungs with foreign material, which, while it may be entirely free from any irritating quality, clogs and finally fills the air cells until they can no longer perform their functions. Coal dust in itself is not particularly dangerous to men of ordinarily robust constitution, nor is the

dust of slate, clay, limestone, or other rock, which consists of relatively smooth, rounded particles. The dust of slate quarries and mills is mostly finely divided clay particles, and is not dangerous.

Mining Progress in British Columbia.

Howard W. DuBois made some remarks regarding his observations in British Columbia during the summer of 1913.

The completion, during the present year, of the Grand Trunk Pacific and of the Canadian Northern Pacific transcontinental railroads across British Columbia, north of the Canadian Pacific Railroad, will be an important factor in the rapid development of the mineral and other resources of the central portions of British Columbia.

The southern portions of the province have already given promise of substantial mining developments wherever railroad facilities have been provided. Owing to the fact that the trend of the mountain folds in British Columbia is approximately north and south, it may be inferred that the geological conditions should be as favorable for successful prospecting and should result in the discovery of orebodies in the north similar to those which have been found and developed into profitable mines in the south.

The region immediately tributary to these new railroads has not as yet received any systematic prospecting, mainly due to the prohibitive cost under which such work had to be carried out. The advent of the railroads will naturally change these conditions, and prospecting has already been begun in advance of their actual completion.

The small amount of prospecting that has been prosecuted in the vicinity of Hazleton, B. C., has resulted in the development of several properties which give evidence of developing into paying mines. The systematic work done by the Granby Company at the Hidden Creek copper property on the Pacific Coast, north of Prince Rupert, indicates that there is at least one large orebody in this region favorably situated for profitable development. Systematic prospecting should be encouraged, to develop more orebodies of similar character.

Placer gold mining has been carried on continuously since 1861 in the interior of British Columbia in the Cariboo and other districts tributary to these new railroads. Naturally this long period of mining operations has exhausted the richer alluvial deposits. The lower-grade gravels are now being worked hydraulickally on a fairly large scale. Systematic drillings for testing purposes are now being carried out to determine whether the

valleys, which were formerly very profitably drifted for their gold contents, are suitable for dredging operations.

The mining laws of British Columbia are much more satisfactory than those in the United States. There is no apex law to cause litigation, and all mineral claims are 1,500 ft. square, with vertical end and side boundaries. The placer deposits, of 80 acres, are leased for a period of 20 years, with a renewal clause for a similar period.

The new railroads are constructed upon such low gradients (only 0.4 per cent is the maximum allowed by the Grand Trunk Pacific) that they will be able to haul ore much more cheaply than the average Western railroad crossing the mountains. This should permit lower freight rates to smelters than is ordinarily enjoyed.

These railroads are to be operated electrically, where conditions are favorable, as soon as the traffic is developed to justify the installation. The Canadian Pacific has already announced its intention to electrify the mountain division for about 600 miles in length, and it will immediately equip one of its branch lines to work out the local details necessary for the adoption of the final plans for the main line.

All of the above features ought to be favorable to the rapid development of the mining industry in that region along conservative lines, and in case electric smelting becomes practicable for general metallurgical operations, that region will enjoy exceptional facilities for its economical development, as well as providing an abundance of electric power for mining and other purposes.

F. Lynwood Garrison,
Secretary of Section.

PERSONAL

F. W. Bradley has given to the University of California, from which he graduated in 1886, the sum of $1,000 per year for ten years, for the purpose of aiding students in the College of Mining whose records and ability "seem to promise that they will be of material service in development of the mining resources of the state." Aid is to be given through loans, and repayments and interest, which is to be charged after graduation, are to be added to the original fund.

Reginald W. Brock, director of the Canadian Geological Survey, has been appointed to the position of Deputy Minister of Mines in succession to Dr. A. P. Low, who has retired.

S. B. Christy is chairman of the San Francisco section of the A. I. M. E.

N. H. Darton made an address on "Mine Gases" before the A. I. M. E. on Jan. 16.

The University of Pennsylvania has conferred on E. V. d'Invilliers the honorary degree of Doctor of Science. Dr. d'Invilliers graduated from the University in 1878, and has been chosen president of his class every year since that date.

J. R. Finlay expects to complete his work in connection with the reorganization of the St. Joseph Lead Co., Bonne Terre, Mo., and to return to New York by March.

H. C. Hoover will arrive from San Francisco on Mar. 4 and will sail for London on Mar. 11.

J. D. Irving, who is completing the Survey monograph of Leadville district, started years ago by late S. F. Emmons, has been there recently securing what is expected will be last data required before publication of the work.

Richard A. Parker has been elected president of the Colorado Scientific Society for this year. Mr. Parker has just undertaken the management of the Argo Mill at Idaho Springs.

William Fleet Robertson, provincial mineralogist for British Columbia, has been appointed provincial assayer as well, the latter office having been vacant since the resignation of Herbert Carmichael at the end of 1912.

E. S. Wiard is designing a mill for the Vindicator mine at Cripple Creek.

MEMBERS ELECTED IN JANUARY, 1914.

Canby, R. C. .....334 South Main St., Wallingford, Conn.
Consulting Metallurgist.

Drury, Walter M. .....165 Broadway, New York
Gen. Mgr. Mexican Dept. Am. Smelting and Refining Co.

Liddell, Donald M.....505 Pearl St., New York
Associate Editor, Engineering and Mining Journal.

Rogers, Alexander P. .....60 Broadway, New York
Consulting Mining Engineer.

Smith, E. A. Cappelen..... .... 165 Broadway, New York
Consulting Metallurgical Engineer, M. Guggenheim's Sons.

Susmann, Julius H. .....42 Broadway, New York
Consulting Mining Engineer.

Mining and Metallurgical Society *of* America

Vol. VII. March 31, 1914. No. 3

ANNOUNCEMENTS

New York Section.—A meeting of the New York section will be held at the Engineers' Club, New York, on Thursday, April 23, 1914, at 8 p.m., preceded by an informal dinner at 6:30 p.m.

Bound Volumes.—Bound volumes of the bulletins published during 1913, including index, are now ready for distribution, and may be obtained from the Secretary at $1.50 a copy. Any member desiring a complete set of the bulletins for 1913, unbound, may obtain it without charge.

Annual Dues.—The annual dues of $10 are now owed. Members are requested to make their checks payable to the "Mining and Metallurgical Society of America." Members who desire the bound volumes of the bulletins for 1914 are requested to remit $1.50 extra. Bound volumes for 1914 will not, of course, be available until after the end of the current year, but it is desirable to know in advance how many will be wanted.

The Medal Presentation.—In receiving the medal of the Society, on March 9, Mr. Hoover made an address, which excited great interest. He desired to revise it before publication, but his MS. was not received up to the time when this bulletin had to go to press. Consequently the account of the medal presentation is delayed until the whole story can be told, which will probably be in the next bulletin.

Souvenir.—With this number of the bulletin is sent to all members of the Society a copy of the souvenir prepared by the dinner committee for the occasion of the presentation of the medal of the Society to Mr. and Mrs. Hoover.

Canadian Mining Institute.—The annual meeting of this Society was held in Montreal March 4-6. The President of the Mining and Metallurgical Society of America appointed Messrs. R. W. Brock, J. B. Tyrrell, and F. C. Loring as delegates to represent it.

W. R. INGALLS,
Secretary.

Ballot on Mining Law Revision.—The ballot upon the recommendations of the Committee on Mining Law, amended by the Council, and in certain cases submitted with alternatives, resulted as follows, as reported by the tellers and the President.

James F. Kemp,
President.

Sir:

The ballot distributed on Feb. 27 was canvassed by us on Mar. 30, with results as follows:

There were 228 members entitled to vote; 97 votes were cast, of which three were discarded because signatures were lacking and one was entirely blank, while some of the members who voted on some questions, did not vote on all.

	Yes	No
1. The mining law should be revised not piece-meal, but thoroughly, so as to co-ordinate and harmonize its various provisions	90	2
2A. (Committee)—Mining claims should be locatable regardless of a "discovery" and held only so long as the specified development work is performed	39	43
2B. (N. Y. Section)—Mining claims should be locatable regardless of a "discovery" and held only so long as the specified development work is performed previous to patenting, provision being made for the patenting and acquiring of absolute title to the property	43	39
3A. (Committee)—Placer locations should be limited to deposits of loose material above solid bed rock. The locator should have a preference right to locate also any lodes developed on his placer ground	60	23
3B. (N. Y. Section)—A uniform type of mineral location should be provided to cover all classes of mineral deposit, whether lode, placer, or any other type, location of and title to which should be subject to the same regulations	21	60
4. A statute of limitations should establish a reasonable term of years beyond which placer patents shall be immune from attack on the ground of fraud	83	8
5A. (Committee)—Provision should be made for the location and working of petroleum, phosphates, rare earths, haloids, and other mineral substances not specifically mentioned in the present law	65	20

5B. (N. Y. Section)—A uniform type of mineral location should be provided to cover all classes of mineral deposit, whether lode, placer or other type, location of and title to which shall be subject to the same regulations	21	56
6. Full privilege of appeal to some competent court of law should be provided for in all cases of contests between rival claimants, or between a locator and the government	88	5
7. Notice of mining locations should be so recorded as to give the fullest possible public notice	90	1
8. The apex law should be abolished	85	5
9. Existing titles should be reaffirmed and fully recognized and no effort should be made to create retroactive legislation	92	
10. For the purpose of giving the fullest consideration to the needs of every branch of the mining industry and every section of the country, it is desirable that a government commission be created by act of Congress, whose duty it shall be to investigate by every proper means the questions and interests here referred to, and to make recommendations as a basis for the proposed mining law revision	89	3

D. M. LIDDELL,
F. W. PARSONS,
Tellers.

The tellers canvassing the ballot of Feb. 27-Mar. 29, 1914, have reported that a majority of the votes cast is in favor of the following resolutions:

1. The mining law should be revised not piecemeal, but thoroughly, so as to co-ordinate and harmonize its various provisions.

2. Mining claims should be locatable regardless of a "discovery" and held only so long as the specified development work is performed previous to patenting, provision being made for the patenting and acquiring of absolute title to the property.

3. Placer locations should be limited to deposits of loose material above solid bed rock. The locator should have a preference right to locate also any lodes developed on his placer ground.

4. A statute of limitations should establish a reasonable term of years beyond which placer patents shall be immune from attack on the ground of fraud.

5. Provision should be made for the location and working of petroleum, phosphates, rare earths, haloids, and other mineral substances not specifically mentioned in the present law.

6. Full privilege of appeal to some competent court of law should be provided for in all cases of contests between rival claimants, or between a locator and the government.

7. Notice of mining locations should be so recorded as to give the fullest possible public notice.

8. The apex law should be abolished.

9. Existing titles should be reaffirmed and fully recognized and no effort should be made to create retroactive legislation.

10. For the purpose of giving the fullest consideration to the needs of every branch of the mining industry and every section of the country, it is desirable that a Government commission be created by act of Congress, whose duty it shall be to investigate by every proper means the questions and interests here referred to, and to make recommendations as a basis for the proposed mining law revision.

I therefore declare the above resolutions to be the action of the Society and its formal expression of opinion.

JAMES F. KEMP,
President.

New York, March 30, 1914.

Revision of Mining Law.—The agitation for a revision of the archaic mining laws of the United States is crystallizing into a prospect of action, Senator Walsh having introduced a bill for the appointment of a commission to study the subject. The bill, as reported from the Committee on Mines and Mining of the Senate, with amendments, is printed elsewhere in this bulletin. Mr. Horace V. Winchell, chairman of the Society's committee on mining law, has been very energetic and influential in inducing this proposed action by Congress. Mr. Winchell writes to the Secretary: "Much credit belongs to the Society for stirring this matter up at an early date. Of one thing I am sure, viz.: our campaign has had an educational value and has justified the labor and expense for that reason alone. I think we should protest vigorously against domination of the commission by mining lawyers."

W. R. INGALLS,
Secretary.

MEETINGS OF SECTIONS

NEW YORK.

A meeting of the New York section was held at the Engineers' Club on the evening of Feb. 20, 1914, the following gentlemen being present: Members: E. G. Spilsbury, H. V. Winchell, Charles Butters, D. M. Riordan, Bradley Stoughton, Robert Linton, George C. Stone, T. T. Read, S. H. Ball, J. F. Kemp, R. M. Catlin, H. H. Knox, Robt. Peele, J. Parke Channing, A. P. Rogers, Otto Sussman, L. D. Huntoon. Guests: Prof. H. C. H. Carpenter, W. S. Stickney, L. V. Emanuel, Mr. Stone, H. A. Guess, George H. Garrey, C. T. Brodrick, C. S. Haley, N. B. Knox, E. Hibbard, T. B. Stearns, G. A. Meyer. The meeting was called to order at 8:30 p. m., by the chairman, Mr. E. G. Spilsbury, who stated that the subject for the evening would be the geology of the Kyshtim copper deposits in Russia. He introduced Mr. A. W. Stickney, whose address was as follows:

The Pyritic Ore Deposits of Kyshtim, Russia.[1]

By A. W. Stickney.

This deposit is a compact, dense, massive aggregate of granular pyrite, barite and quartz, carrying irregular blotches, streaks, and minute grains of chalcopyrite, spalerite, and tennantite. The evidence indicates that the ore is the result of the metasomatic replacement[2] of alternating bands of a sheared and broken schist by a rather fine-grained, cracked, and broken pyrite, anhedral barite, and quartz. This granular aggregate, contained considerable open interstitial space, which was later filled by contemporaneous chalcopyrite, sphalerite, and tennantite. Tennantite probably also marks a slightly later stage[3] in the primary mineralization, and with it are contemporaneously associated chalcopyrite

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[1] These are brief excerpts from a paper to be presented later to the Harvard Mining School, and to be published as part of a forthcoming paper on the character of the general metallization in the Ural Region, in joint authorship with Mr. C. T. Brodrick.

[2] "An Instance of Secondary Impoverishment," by H. H. Knox, Trans. I. M. M., Vol. XVIII, 1909, pp. 273-290.

[3] H. W. Turner: *Min. Mag.*, Vol. VI, No. 6, 1912, p. 445.

and quartz of a second generation. The paragenesis of the sulphide minerals is one of decreasing iron, increasing copper contents.

The orebodies, as viewed in a vertical section, normally show four distinct, roughly horizontal and parallel zones. From the outcrop downwards they may be designated as: (1) the gossan zone, which extends from the surface to a maximum depth of 60 ft.; (2) the zone of loose baritic sand, extending from the bottom of the gossan to a maximum depth of 150 ft., the greater portion of which lies beneath the level of the ground water; (3) the loose, leached sulphides, which reach from the bottom of the baritic sand to a maximum depth of 180 ft., where they gradually pass into (4) the underlying, firm, massive, mainly unaltered sulphide ore.

The evidence indicates that the gossan is the result of normal processes of oxidation acting upon the massive sulphide ore, since the gossan (*a*) displays the honey-comb, skeleton form of the primary ore with the metallic sulphides removed; (*b*) overlies a much narrower zone of loose baritic sand, which carries only about one-fourth as much iron as the gossan, and is strikingly distinguished from the gossan zone by a broken and caved hanging wall; and (*c*) this broken hanging wall reaches the surface in the case of the one lode of which the outcrop is predominantly baritic sand. It is believed that during a period in the remote past the rate of denudation has been much faster, as the result of a steeper gradient or of glaciation, whence the massive pyritic ore was kept so near to the surface that an excess of oxygen was always immediately available to convert into limonite the iron of any ferrous sulphate formed. Since that time these conditions have ceased to exist, owing to long continued erosion or to climatic changes. The baritic sand is regarded as the result of leaching by surface waters, which probably contains sulphuric acid, but were deficient in oxygen; the iron sulphate and much of the copper sulphate thereby generated were lost by diffusion into the relatively more permeable wall rock.

As this leaching has occurred to as great a depth as 110 ft. below the ground-water level which apparently has been stationary for a long period, it is inferred that the upper portion, at least, of the ground water is not so stagnant as some have supposed. A distinct circulation of this water, both vertically and horizontally is suggested. There is no evidence to support the hypothesis that the gossan was formed by iron sulphate solutions, ascend-

ing through the underlying extensive zone of baritic sand, the iron being fixed as limonite in the gossan by descending surface waters heavily charged with oxygen. There is nothing to suggest that gossan is being formed at the present time; on the contrary, it is inferred that all the present gossan is a remnant of that formed in a previous period, which has not as yet been removed by erosion except in the case of one lode, where topographic conditions appear to have been and are still favorable to rapid denudation. Here the underlying zone of baritic sand outcrops.

Downward enrichment of secondary sulphide does not occur in the form of a shallow, well developed, commercially important, horizontal zone, typical of many other localities, but has taken place to a relatively slight degree along the immediate walls, especially the hanging wall, to the greatest depth yet attained in exploration, which is 600 ft. below the ground-water level.

The massive pyritic ore of a given lode shows a progressive longitudinal variation in relative mineralogical character, from a condition of maximum intensity of mineralization near the longitudinal centre of the lode, which continues downward to the greatest depth yet reached.

The character and composition of the ore, and the nature of the hydrothermal alteration of the wall rock, indicate that the deposits have been formed through metasomatic replacement, along a sheared zone of the schist, by pyrite and barite, molecule by molecule, band by band, thus preserving the original banding of the schist; also, that the deposition took place during a distinct mineralizing epoch, marked by solutions progressively changing in composition and depositing a series of sulphide minerals in transitional order. From the absence of characteristic ore minerals in the adjacent altered country rock, and the presence of sericite, barite, and quartz, it is concluded that the mineralization was effected by hot alkaline solutions at a temperature and pressure corresponding to what Lindgren in his "Mineral Deposits" calls the zone of intermediate depth.

H. V. Winchell.—This has been the clearest and most concise, and at the same time most comprehensive and well-digested description of an interesting and important mining district that I have ever heard. It presents the result of exhaustive investigation, carefully observed and thoughtfully analyzed. Such observations as these are of the utmost value to the student of ore

deposits, as indicating the relationship and genesis of minerals, and guiding the exploration and development of mines.

At this time I wish to ask but one question namely, whether there is any native copper in the gossan.

A. W. Stickney—I have never seen any native copper in the gossan nor in the thin sections.

H. V. Winchell.—I was wondering, also, whether there is any manganese. Its absence, I presume, would account for the enrichment in silver and for the absence of enrichment in gold.

A. W. Stickney.—The ore carries no manganese, and since the gold generally maintains the same ratio to the barite and quartz in the gossan as it does in the zones of baritic sand, impoverished sulphides, and primary ore, it is believed that this shows only relative enrichment in the gossan, by solution and removal of other primary constituents. No solution, transportation, nor enrichment of gold is suggested, as might have been the case if manganese were present. On the other hand, the probable formation of sulphuric acid during oxidation of the primary sulphides suggests that some of the silver would be taken into solution and transported to a lower horizon. But, on the contrary, the gossan shows no impoverishment in silver, but a distinct enrichment. Just how the absence of manganese would explain this positive enrichment of silver in the gossan I am unable to say.

D. M. Riordan.—Did you find any bornite?

A. W. Stickney.—Yes; a very small amount occurs locally in primary intergrowth with pyrite and chalcopyrite, wherever these are associated with more than the usual quantities of sphalerite and galena. This infrequent and local variation in the ore takes the form of small non-persistent bands.

D. M. Riordan.—How deep are they?

A. W. Stickney.—They have been observed on the first, the second, and, I think, the third levels, that is, to a vertical depth of 460 feet.

R. Peele.—You mentioned the presence of covellite. In what part of the orebodies does it occur?

A. W. Stickney.—Wherever covellite has been observed, it replaces some one of the primary sulphides, frequently sphalerite.

R. Peele.—Is there much variation in its occurencc with depth?

A. W. Stickney.—Yes; covellite occurs most abundantly along the walls in the upper portion of the zone of firm, massive sulphide ore, and decreases in amount with depth. In the core from the deepest boreholes (vertical depth 1000 ft.) no covellite has been found.

R. Peele.—When you were speaking of the ore deposits themselves as developed in the four or five different mines of the company, you used an expression that might lead one to think they are separate lodes. As I understand it, there are a series of separate orebodies in a long belt. Has any diamond drilling been done along the strike of the ore between these mines?

A. W. Stickney.—Yes; the several lodes are separate and distinct bodies arranged in series in a belt of thinly foliated schist, with one exception, that of the two lodes known as the Smirnoff West and East veins, which occur *en echelon* when viewed in horizontal plan, and on roughly parallel lines separated by about 110 ft. The longitudinal interval along the schist belt between successive orebodies varies from ¼ mile to two miles. Between the several orebodies, the schist belt is more or less silicified and impregnated by pyrite. These intermediate stretches along the belt of schist have been opened up at the surface by detailed trenching, which, in fact, led to the discovery of the Americansky and Ivanoff lodes. Furthermore, where the intervening areas between the orebodies are covered by deep alluvium or marshes, detailed diamond drilling has been done at frequent longitudinal intervals.

J. E. Kemp.—I desire to speak also in warm commendation of the paper presented by Mr. Stickney, and to express the pleasure with which we have followed the results of this very careful study. I should like to ask Mr. Stickney if his studies have led him to any conclusions regarding the method of formation of sericite. There has been some discussion among geologists as to whether or not it was always the result of the action of the waters. Probably it is—and as Mr. Stickney has mentioned its presence near the ore, I would like to ask his views.

A. W. Stickney.—The sericite is intimately connected with the pyritic mineralization, and investigation indicates that it is one of the products of the alteration of the wall rock, adjacent to the orebodies, by mineralizing solutions.

J. Parke Channing.—Does any of that gossan look as though it might have been produced by ascending waters?

A. W. Stickney.—No; I have been unable to find any evidence to support the hypothesis that the gossan was formed by iron sulphate solutions, generated in the zone of impoverished sulphides, then ascending through the extensive zone of baritic sand, and finally having their iron fixed as limonite in the gossan by descending surface waters charged with oxygen. The physical character of the gossan, in which the barite and quartz form a network of small grains exhibiting the skeleton frame of the firm sulphide ore, and being held in place by shells of limonite or hematite which partially fill the casts of the former sulphides, contrasted with the loose baritic sand, which does not show the framework of the firm sulphide ore; its chemical composition as compared with the underlying zone of baritic sand; and its comparative width, together with the absence of a broken hanging wall, as contrasted with the settled hanging wall in the zone of baritic sand, all point to the conclusion that the gossan is the result of normal processes of oxidation, acting on the massive sulphide ore.

J. Parke Channing.—No doubt you have seen gossan from ascending waters. I spent several thousand dollars on one, and found nothing underneath except a small crack through which the water came. This was in Shasta county, California.

H. H. Knox.—I would like to remind Mr. Channing of one of the greatest gossans in the world, formed by horizontal deposition. The Mesa de los Pinos, at Rio Tinto, formerly covered many square miles to a thickness, say, of 100 ft. It was formed by the oxidation of sulphate solutions proceeding from the outcrops of the sulphide orebodies and transported many miles before final deposition as limonite. This is an example of the horizontal spread of a gossan on an enormous scale.

H. V. Winchell.—There are some gossans derived by precipitation from evaporated hot spring waters. The waters coming to the surface contain iron which they precipitate in large amounts, making something which, in chemical composition, resembles a gossan.

Does the banding in this piece of drill core represent a horizontal banding?

A. W. Stickney.—No; the banding in the ore is parallel to the lode walls, that is, it dips some 60° to the east.

T. T. Read.—Do you regard the narrowing of the veins at the level of the baritic sand as accidental, or of structural significance?

A. W. Stickney.—It is the result of the leaching out of sulphides in the primary ore at this zone. The accompanying decrease in volume and width of the lodes at this horizon has been followed by a settling of the hanging wall.

H. V. Winchell.—Has anything filled in the cracks in the hanging wall, where this settling has occurred?

A. W. Stickney.—A little clayey material, possibly, but small voids still remain in the immediate hanging wall schists.

E. G. Spilsbury.—Is there any indication of depression on the surface along a line back of the veins?

A. W. Stickney.—No; there is no depression at the surface over the hanging wall side. The amount of settling opposite the baritic sand has apparently been too slight to affect the schist more than a few feet from the lodes, and this is confined to the hanging wall immediately adjacent to the zone of baritic sand.

D. M. Riordan.—Would the mine be called a "wet mine"?

A. W. Stickney.—The Koniukhoff mine makes 50 gal. per min., the other mines somewhat less.

J. Parke Channing.—Where do they get the quartz required to smelt this ore?

A. W. Stickney.—The quartz comes from a somewhat impure quartzite formation in the old, possibly pre-Cambrian, granite-gneiss and biotite schist complex, forming the core of the Ural Mountains, and is brought to the smelter, a distance of some 10 miles, by railroad. Numerous veins of purer quartz occur in the vicinity, but they have all proved too small and do not carry sufficient gold to make it a profitable undertaking to work them, even as a source of flux. The flux is used in the smelting operation forms 20 to 25% of the charge, by volume, the mixture consisting of 75% ore, 15% quartz, 5% limestone, and 1¼ to 1½% coke.

On motion, duly seconded, a vote of thanks to Mr. Stickney, for the splendid lecture he had given, was unanimously carried.

The meeting adjourned at 10:55 p. m.

LOUIS D. HUNTOON,
Secretary of Section.

COMMUNICATIONS

Revision of the Mining Law.

George E. Collins.—With respect to the ballot of Feb. 27 on the Mining Law Committee's recommendations, I am sending my ballot filled in only as to propositions 5-A, 6, 7, 9 and 10. With respect to the others, I do not think that the time is yet ripe for a definite vote.

For several months I have been serving as chairman of a committee appointed by the Colorado Scientific Society to consider the recommendations of the Winchell Committee, and also those outlined in a recent address by the Director of the Geological Survey, as to their probable bearing on Colorado conditions. At the outset practically all, if not all, of our committee were in favor of the Winchell recommendations; and I believe that most of us still favor them in principle; but in the course of our investigation we have been deeply impressed by the possibilities of unfavorable developments in Congress if the question is brought up at this time, particularly in face of the strong and growing spirit which leans toward Federal control of the resources of the public lands, under the guise of conservation. The present feeling in our committee is towards caution, pending further study and investigation of the subject.

We have requested the Colorado Bar Association to appoint a committee to meet with ours, in order to assist us in weighing the legal aspects of the questions involved; and we believe that such a committee will be appointed in the near future. Meantime, none of us, I think, would be justified in casting a definite vote on the other recommendations of the Winchell committee.

Horace V. Winchell.—Although the members of the Mining and Metallurgical Society have not yet voted on the recommendations of their committee on mining law, yet there is an opportunity for them to be of immediate service in connection with pending legislation in Congress. You will remember that the committee recommended the creation by Congress of a Commission to study and report the draft of a bill embodying desirable amendments to the present laws. Such action is now contemplated in Senate Bill 4373, which was introduced by Senator Smoot on Feb. 5.

The bill as originally introduced provided for the appointment of a Commission of three, of whom one should be a man of practical experience in mining, one a mining lawyer and one a member of the U. S. Geological Survey. It also provided that the commission should not include coal, oil, gas, phosphates,

salines, etc., in their investigations. In other words, it was to be limited practically to the metal-mining laws and deposits.

We heartily favor the establishment of such a commission. But we deem it important that it should be large enough to contain a liberal representation of men of experience in the actual working out of the mining laws. Otherwise it will be difficult to convince the mining communities that their interests are actually being considered. We also believe that the Commission should be unrestricted in the scope of their field of investigation, and cover the entire field of mineral deposits, so that the law finally passed may best co-ordinate all classes of ores and all departments of the mining industry.

Do you not think it proper for you to address a letter to all the members of the Society, asking them each to write to their Senators and Congressmen, urging the passage of the bill with the amendments suggested above? The time to act is now when the matter is receiving the attention of Congress.

THE PROPOSED MINING LAW COMMISSION

The following is the text of Senate Bill No. 4373, introduced by Senator Smoot on Feb. 5, 1914, and reported out of the Committee on Mines and Mining by Senator Walsh, with amendments, on March 16, 1914:

A BILL to provide for a commission to codify and suggest amendments to the general mining laws.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President shall nominate and by and with the advice and consent of the Senate, appoint a commission of three members, two of whom shall be lawyers of large experience in the practice of mining law and one a mining engineer who shall have had practical experience in the operation of mines.

Sec. 2. That it shall be the duty of the commission so appointed to prepare for the information and use of the President and Congress a tentative code of laws providing for the location, development, and disposition of mineral lands and mining rights in the lands of the United States, including the Territory of Alaska, as in the opinion of the commission are best adapted to existing conditions and will correct defects or supply deficiencies in existing general mining laws.

Sec. 3. That the commission shall hold public hearings in the principal mining centers in the western United States and Alaska; invite and receive suggestions and opinions bearing upon or relating to existing mining laws or desirable amendments thereof; and may also consider the laws and experience of other countries with respect to disposition and development of mines and minerals.

Sec. 4. That within one year after the passage of this Act, at which time the said commission shall expire, it shall submit to the President full report as to its operations, conclusions, and recommendations, including in or transmitting with said report a tentative code of mineral laws, as provided in section two hereof, and within thirty days from receipt thereof the President shall transmit the same to Congress with his recommendations.

Sec. 5. That each of said commissioners shall receive a salary of $500 per month, and for the payment thereof and of the actual and necessary expenses of the commission, including traveling expenses, the sum of $25,000, or so much thereof as may be necessary, is hereby appropriated out of any money in the Treasury not otherwise appropriated.

PERSONALS

Henry S. Drinker has been elected president of the American Forestry Association.

Edward D. Peters was a guest of honor at the sixteenth annual meeting of the Canadian Mining Institute, held in Montreal, on March 4, 5 and 6. He addressed the institute on the subject of "The Production of Heat in Metallurgical Furnaces."

R. T. White, formerly manager of the Braden Copper Co. in Chile, is going to the Caucasus, South Russia, to take charge of a copper operation there.

MEMBERS ELECTED IN MARCH, 1914

Colvocoresses, George M.....43 Exchange Pl., New York
Mining and Metallurgical Engineer.

Guiterman, Franklin .....165 Broadway, New York
Mining Engineer; Director, American Smelting & Refining Co., etc.

Hague, William.....Grass Valley, Calif.
Managing Director, North Star Mines Co.

Johnson, Joseph E., Jr.....52 William St., New York
Consulting Engineer and Metallurgist.

Linton, Robert .....25 Broad St., New York
Consulting Mining Engineer.

Robbins, Percy A. .....Timmins, Ontario
Gen. Mgr., Hollinger Gold Mines, Ltd., etc.

Saunders, William L. .....11 Broadway, New York
Chairman, Board of Directors, Ingersoll-Rand Co.

Tillson, Benjamin F. .....Franklin Furnace, N. J.
Head of Mining Dept., N. J. Zinc Co.

Webb, Harry H. .....233 Broadway, New York
Consulting Engineer, Consolidated Gold Fields of So. Africa.

Mining and Metallurgical Society *of* America

Vol. VII. April 30, 1914. No. 4

ANNOUNCEMENTS

New York Section.—The executive committee of the New York section has decided to hold no meeting in May in view of the near approach of the summer season. The next meeting of the section will be in September or October, notice of which will be given in the bulletin in due time.

During the last season there have been seven meetings, with an average attendance of 24, all of which have been very successful.

San Francisco Section.—A meeting of the San Francisco section has been called for May 4.

Bound Volumes.—Bound volumes of the bulletins published during 1913, including index, are now ready for distribution, and may be obtained from the Secretary at $1.50 a copy. Any member desiring a complete set of the bulletins for 1913, unbound, may obtain it without charge.

Erratum.—Through an error in "making up," a portion of the communication by George E. Collins on "Standardization," published in the November bulletin, was transposed and was annexed to a communication on the same subject by Hennen Jennings. The matter referred to begins with "I suggest the following:" on page 304 and runs over to 306.

Increase in Membership.—With this bulletin an application blank is sent to all members of the Society, with the suggestion that they hand it to some one who is eligible for membership in the Society, and has not yet made application. Additional blanks—also copies of the Constitution and List of Members—may be obtained from the Secretary.

W. R. Ingalls, *Secretary.*

MEETINGS OF SECTIONS

NEW YORK

A meeting of the New York section was held at the Engineers' Club, New York, on Thursday, March 19, 1914, at 8:25 p.m., Mr. E. Gybbon Spilsbury presiding. Those present were: John H. Allen, S. H. Ball, R. M. Catlin, C. W. Goodale, H. W. Hardinge, W. R. Ingalls, J. E. Johnson, Jr., D. M. Liddell, T. T. Read, A. H. Rogers, W. L. Saunders, E. G. Spilsbury, Bradley Stoughton, and S. T. Wellman.

The Chairman.—As we have not anything definite for discussion this evening, the idea was that we would discuss Society matters generally. But since that time we have been favored with the presence of Mr. Goodale, and I think that if he will give us a talk on the condition of affairs at Great Falls, it will be of great interest to all the members.

Work at Boston and Montana Plant.

C. W. Goodale.—In speaking of Great Falls, or asking for information from there, I presume you mean the operations of copper mining and metallurgy in the state, rather than at Great Falls. It has been decided by the Anaconda Copper Mining Co., the operating company, that concentrating should no longer be done in Great Falls. Up to the present time we have treated about 3000 tons a day there, and very soon the Anaconda concentrator will be so increased in capacity that it can take over this 3000 tons a day and then ship to us the concentrates, about 1000 tons a day. It is very easy to see where that is the logical thing to do, as the concentrator at Great Falls is very old, some of the plant dating back twenty-three years, and the cost of building a concentrator on modern lines would mean a large expenditure of money. Furthermore, the cost of hauling ore from Butte to Great Falls is about 75 cents a ton, as against 14 cents from Butte to Anaconda, twenty-five miles. The management at Great Falls will feel very sorry to see an important department of its operations taken away, but that is the logical outcome of conditions.

An expenditure of more than $2,000,000 was authorized in 1912 for replacing the main smelter building at Great Falls with a higher and stronger structure, and for new and modern furnaces and converters. Last year the old main smelter building, 704 ft. x 51 ft., with a height of 23 ft. 7 in. to the crane rails, was removed and the new building occupying the same site was completed. It is 824 ft. long, with a width of 56 ft., and a height of 42 ft. to the crane rails. Three old cranes of 40 tons' capacity

were replaced by three new ones of the same capacity, but with modern improvements. The walls of the building are of brick.

The three new basic-lined converters, 20 ft. in diameter, are in place, and the old ones, 12 ft. in diameter, are set aside. One of these bowls had a record of 20,000 tons of copper blown without relining, and when discarded it was in condition for indefinite further use. The converters which were originally installed in 1891 were 7 ft. in diameter, then came the 12 ft., and finally the 20 ft. converters.

Our new reverberatory furnace has been built, and results show such an improvement over the work done by the old gas-fired furnaces, that another one is now in process of construction. The hearth is 102 ft. long and 22 ft. wide, and the fire-box is really a large gas producer in which we can gasify more than 100 tons of coal per day, while the old producers could only handle 10 or 12 tons daily. No provision has yet been made for preheating the air used in combustion, but hot-blast stoves will soon be built for the purpose, and it is expected that the present capacity of 250 tons of charge per furnace day will be increased to more than 300 when these stoves, which will use the waste heat of the furnace, are in action. Our present ratio of coal to charge is about 1 to 2½, the fuel being of rather inferior quality, —22% ash. There are some new features in the construction of the furnace, particularly in the binding, the usual buckstays and the rods across the top of the furnace being avoided by the use of a heavy, steel-plate shell with a number of angle-braces on the sides, provision being made for expansion and contraction.

The old McDougall roasters, 16 ft. in diameter, will be discarded as soon as the new ones, 24 ft., are built. Our present blast furnaces are 15 ft. long, but in the new plant we shall follow Mr. Mathewson's lead and build them longer. At Anaconda preparations are being made to use pulverized coal in the reverberatories, and judging by results obtained in other places where coal-dust firing is in use, a considerable saving will be effected in costs of smelting. If members desire to obtain more particulars regarding metallurgical practice in Montana, they will find them in the papers presented at the Butte meeting of the American Institute of Mining Engineers in August, 1913.

Replying to a question by one of the members:—A black bug or beetle, locally called the "slag-bug," is found around the Montana smelters in the summer, and his favorite place of attack is the back of the neck of the smelterman, where his nip or pinch causes some discomfort and strong language. No doubt he has a long name and full description in the books of "bug-ology."

During the past year an interesting tin mineral was found in Butte, and as it was first discovered in the Colusa vein, one of the early locations of the district, we have called it Colusite. Here is a partial analysis of one specimen: Cu, 46.1 per cent.; Fe, 1.8 per cent.; S, 28.4 per cent.; As, 6.5 per cent.; Sb, 2.5 per cent.; Sn, 6.6 per cent.; Te, 3.1 per cent.; Au, 7.55 oz. p. t.; Ag, 15.80 oz. p. t.; total, 95.0 per cent. The appearance of the mineral in a polished section under the microscope leads to the conclusion that it is complex, perhaps a mixture of stannite, tetrahedrite, a telluride of gold, and other minerals. Ten specimens have been analyzed, including several from the Mountain View mine, and variations in compositions are found, so that further study may show that it is not entitled to a name for a new mineral.

The One-Man Drill.

The chairman then called on Mr. Catlin, asking him whether he had anything new to tell the members about the one-man drill.

R. M. Catlin.—I have nothing very new to say about the one-man drill, but I think it has come to stay in certain places. We are trying it now in sinking; in raising, of course, there is nothing can approach it. In quarry work, we have found it much more economical to put in a number of small holes, than several large ones, as less block hole work is required.

E. G. Spilsbury.—You are using the hollow steel, of course, and have no trouble?

R. M. Catlin.—If we have plenty of water, there is no trouble. For experiment I took one of the drills and started a hole in a puddle of water that had frozen over—probably 3 in. of ice and 4 in. of water. I drilled through the ice and then went into the rock, and had no trouble at all in putting down a 9 ft. hole. As you know, our rock is different from quarries. It took me about three years before I really believed that we had hard rock. The rock is not hard, measured by the ordinary hardness scale, but when it comes to breaking, there are places that keep up their end.

W. R. Ingalls.—What has been your experience with different steels in drilling this rock?

R. M. Catlin.—Very perplexing. It is not always the highest priced steel from which we have obtained the best results. We have had steels at 15 cents or 20 cents which were not in it with some at half the price. I think the hammer-drill people have gotten away ahead of the steel people. The conditions are quite different with a reciprocating drill from what they are where you are drilling with, say, sixteen or eighteen hundred blows a minute. We often find differences of temperature in the steel; it may be perfectly cool in one place, then hot in another, then cool again. It is not an uncommon thing for the steel to break in three pieces. In the fracture it seems as though there often is a little nucleus from which an internal crack develops.

I think there ought to be some way of studying this problem, and arriving at a steel that will stand up for this service a good deal better than the steel we are getting.

T. T. Read.—Have you tried any cobalt steel?

R. M. Catlin.—No, we have tried nearly all other kinds, but I don't recall that we have tried that.

After general discussion by the members on the topics spoken of during the evening the meeting adjourned at 10:30 p.m.

D. M. Liddell,
Acting Secretary.

PERSONALS

Lawrence Addicks, who has been superintendent of the Chrome refinery of the United States Metals Refining Co. for the last eight and connected with it for about 10 years, has resigned.

Walter H. Aldridge was married on March 18 to Miss Maud Miller, at Oakland, Calif.

L. D. Huntoon has resigned as secretary of the New York section, and D. M. Liddell has been elected to fill the vacancy.

George A. Laird is no longer connected with the Great Cobar, Ltd., but has opened an office in Sydney, N. S. W., to carry on a general consulting practice.

CHANGES IN ADDRESSES

Bellinger, H. C. .....Spokane, Wash.
Laird, George A. .....49 Clarence St., Sydney, N. S. W.
Morley, F. H. .....Santa Barbara, Cal.
Parker, Richard A.....Equitable Bldg., Denver, Colo.
Payne, Henry M. .....55 Liberty St., New York
Turner, H. W.,
207 Alaska Commercial Bldg., San Francisco, Cal.
Williams, Ralph B. .....Box 278, Birmingham, Ala.

Mining and Metallurgical Society *of* America

Vol. VII. May 31, 1914. No. 5

ANNOUNCEMENTS.

Bound Volumes.—Bound volumes of the bulletins published during 1913, including index, may be obtained from the Secretary at $1.50 a copy. Any member desiring a complete set of the bulletins for 1913, unbound, may obtain it without charge.

Subjects of Discussion.—All members of the Society are invited to bring to the attention of the council subjects which they may consider to be open to useful, interesting and profitable discussion.

Membership.—The present membership of the Society is over 250. According to the by-laws of the Society names of persons are not proposed by a member, but anybody desiring to be a member proposes himself, and it is not necessary to wait for an invitation. Members of the Society may, however, suggest to engineers of their acquaintance the desirability of joining the Society and offer themselves as endorsers. The membership of the Society ought to be increased. The council requests that every member of the Society interest himself in promoting an increase.

International Congress of Mining and Metallurgy.—The Sixth International Congress of Mining, Metallurgy, Engineering and Economic Geology will be held in London from Monday, July 12, to Saturday, July 17, 1915. The Congress will be divided in the following sections: I, Mining; II, Metallurgy; III, Engineering; IV, Economic Geology. Participants in the Congress may be: (a) Honorary Members; and Delegates of Foreign States. (b) Supporters of the Congress, i. e., contributors of not less than £5 to the Fund. (c) Ordinary Members who pay a Congress fee of £1, which entitles them to registration in any one of the four sections. These may register in any other sections by making a further payment of 5s. for each section. The Honorary Members of the Congress and the Supporters will receive all publications of the Congress. Ordinary Members

will receive the Transactions of that section in which they may elect to register by payment of the fee, £1. They can, however, receive the Transactions of any other section on payment of the additional charge of 5s. per section referred to above. The authorized languages at the meetings are English, French and German. The official language of the Congress is English.

The Executive Committee has drawn up a list of selected subjects for discussion at the Congress and has invited authorities to prepare papers thereon. In addition to these the committee is prepared to accept a limited number of other papers, if found suitable for the objects of the Congress. All papers must reach the Committee not later than Jan. 31, 1915. Papers may be submitted in any of the three authorized languages, (English, French, German) and must be accompanied by a short abstract in the same language as the paper. The papers will be printed in one of the three languages, and the abstracts will be printed in all three languages. At the meetings of the sections of the Congress the papers will not be read, but authors will be invited to introduce the subjects of their papers for purposes of discussion. Except in special cases, the time allowed to authors for the introduction of their subject shall not exceed 15 minutes. Copies of the papers will be circulated in advance, and the abstracts will, as far as possible, be placed at the disposal of the Members of the Congress at the opening of each meeting at which the papers are to be discussed.

Any inquiries for further information should be addressed to the Secretary of the International Congress, 28 Victoria St., London, S. W.

W. R. Ingalls, *Secretary.*

COUNCIL.

A meeting of the council was held at the Engineers' Club, New York, on Tuesday, May 5, at 5 p. m. The members present were Messrs. Kemp. Garrison, Channing, Finlay, Stone and Ingalls, a total of six, this constituting a quorum. The President occupied the chair.

It was moved and seconded that the executive committee be clothed with all the power of the council except in the election of new members of the Society, in which it may exercise only its usual functions as prescribed in the by-laws. This motion was unanimously carried.

It was moved and seconded that all actions by the executive committee up to this date in 1914 be approved, ratified and confirmed. This motion was unanimously carried.

The Secretary reported receipt of a communication from Mr. B. B. Lawrence, suggesting the following subject for discussion by the Society:

"Should the Under-Graduates in our Universities, Taking Engineering Courses, Be Required to Have Previous Academic Training as is the Case in Law and Medicine? In other words, will it contribute to the benefit of the professions of Engineering that our leading universities should make their courses in Engineering post-graduate courses?"

Upon motion, duly seconded, the Secretary was instructed to print Mr. Lawrence's communication in the bulletin of the Society and invite discussion of it.

W. R. Ingalls, *Secretary.*

MEETINGS OF SECTIONS.

NEW YORK

A meeting of the New York Section was held at the Engineers' Club on Thursday, Apr. 23, 1914, at 8:30 p. m., Mr. E. Gybbon Spilsbury presiding. The following members and guests were present: R. M. Catlin, J. Parke Channing, J. V. N. Dorr, J. R. Finlay, H. W. Hardinge, F. L. Hess, J. A. Holmes, L. D. Huntoon, J. F. Kemp, J. V. Lewis, D. M. Liddell, T. T. Read, D. M. Riordan, S. F. Shaw, W. L. Saunders, E. G. Spilsbury, G. C. Stone; (Guests) Charles Baskerville, A. R. Ledoux, O. G. Meyer, H. C. Parmelee, R. M. Raymond, G. Rigg, E. M. Rogers, P. G. Spilsbury, G. D. Van Arsdale, and Mr. Wotherspoon.

The Chairman.—I regret that we have before us the resignation of our efficient secretary, Mr. Huntoon. His business is growing to such an extent that he feels it is no longer possible for him to give such attention to the affairs of the Section as he has heretofore. I am sorry that we shall have to accept his resignation. It will therefore be in order to nominate a new secretary.

Mr. Huntoon nominated Mr. D. M. Liddell. The nomination was seconded by Mr. Channing, and, there being no further nominations, Mr. Liddell was declared unanimously elected.

The Chairman.—The subject for discussion this evening is "Radium," and I trust everybody has come primed with something to say about it. We have with us Mr. Frank L. Hess, of the U. S. Geological Survey, who will tell us of the geological occurrences and the mining of the ore.

Mr. Hess.—The carnotite fields of the United States contain the greatest quantities of uranium minerals of all known deposits. These lie in the high plateau region between the Rocky Mountains in Colorado and the San Rafael Swell in Utah; practically all are south of the Denver & Rio Grande Ry., and, as at present known, the deposits extend just below the Arizona line. Outside of this large area, which includes the famous Paradox Valley and the adjacent areas in Utah, there are several localities where similar uranium ores occur in small quantity. All lie in cross-bedded sandstone, which is probably of Jurassic age.

How that great area of cross-bedded sandstones originated has long been a problem. My idea is that a shallow sea, probably salt, because there are few remains of animal life in the sandstones, covered the whole area. It was so shallow that the wind blowing for a long time in one direction would pile up the water at the lee end and many low islands and spits would be formed. I know of only two ways by which water-laid cross-bedded sandstone can be formed—by deposition on beaches and by river-bed deposition; I cannot imagine a river flowing through that country in such manner as to cause these deposits.

A remarkable feature of these beds is the presence of a tremendous quantity of fossil wood. You find it everywhere in them. The trees reach 50 or 60 ft. in length and 6 ft. in diameter. They are all water-worn, exactly as you find the trunks of trees along rivers and sea coast to-day. That proves that these trees had been floating in water, and what is more natural than that the trees should have floated around in this sea, lodged on the islands, and been covered by succeeding layers of sands? Except in non-commercial quantities, carnotite deposits are found only with the fossil remains of these old trees and reeds. Two important facts are, that the carnotite is found only with the wood and other fossil vegetation, and that in the deposits there is always an excess of vanadium, though were carnotite alone present there should be three times as much uranium as vanadium. For convenient reference, I have prepared this table of uranium minerals:

Carnotite	K_2O	
Tyuyamunite	CaO	$2UO_3.U_2O_5.xH_2O$
Unidentified	$CaO+BaO$	
Torbernite	CuO	
Autunite	CaO	$2UO_3.P_2O_5.8H_2O$
Uranocircite	BaO	
Zeunerite	CuO	
Uranospinite	CaO	$2UO_3.As_2O_5.8H_2O$

I believe that around these old seas were veins which were weathering away, and the sulphuric acid thus formed from pyrite attacked the other minerals of the veins and carried the metals as sulphates into the shallow sea, forming a very dilute solution from which, on its coming in contact with the organic matter, they were reduced to sulphides and were deposited with the organic material; that is the reason we never find carnotite without vegetable remains. Most of the deposits are small because the patches of drift were of small extent. A peculiar phenomenon is that some of the vanadium deposits contain selenium in elemental form.

The Chairman.—I would like to ask Mr. Hess if he has found these remains of trees and vegetation where the vanadium alone has been deposited. I, myself, have never been able to detect an occurrence of that nature in those beds.

Mr. Hess.—I have found none.

Mr. Liddell.—Do you find traces of uranium and vanadium in the Triassic and Jurassic beds of the eastern slope of the Colorado Rockies, for instance, in the Garden of the Gods?

Mr. Hess.—Vanadium has been found, but I believe not in commercial quantities.

J. F. Kemp.—While Mr. Hess was describing the sandstones in western Colorado and eastern Utah, which make somewhat of a ring-shaped series of outcrops, I could not help wondering whether they could not be interpreted as the terrestrial deposits, partly windblown, partly torrential, partly the work of quieter streams. This interpretation has cleared up a number of puzzling geological problems in the cases of other formations. The great numbers of tree trunks rather coincide with this suggestion. They might have come in upon streams at flood.

The radio-active minerals are characteristic of pegmatites rather more than of any other form of deposit. One cannot well avoid wondering again if pegmatites were not present in the land area which furnished the sedimentary materials to the uranium-bearing sandstones. Autunite is commercially produced from a famous pegmatite dike at Garda, Portugal, and is found in remarkably fine groups of crystals. For mineral cabinets, as we all know, autunite has long been known in the gneisses of Philadelphia, coating crevices.

A curious series of observations accumulated several years ago from the work of one of my old students, David C. Condict, at the time connected with the Ohio State Survey, and

working up his results in our laboratory. Mr. Condict investigated the sandstones of the Paleozoic strata of Ohio. Among other tests he crushed and panned down samples of them all for the minute heavy minerals. To his surprise he found monazite suddenly entering one, I think of Carboniferous age, as a scarce but characteristic component. Its presence led to the conclusion that the materials for this sandstone had come from a different source than had those of the earlier measures, and that granites or pegmatites had been their original source.

Mr. Hess.—As to the origin of these cross-bedded sandstones: On examining the grains of sand that make up the beds they are found to be exceedingly angular, and that is one reason for doubting that they are wind-blown. If they had been wind-blown, and the trees had been brought in by floods, I believe the floods would have washed the sands in such a way that the cross-bedding would have been largely obliterated. Again, there is no large gravel; the biggest I have found is about 1 in. in longest diameter.

The Chairman.—One point which has struck me as very remarkable is that in that lower Placerville district the sandstone beds are so regular and uniform, not only in thickness and in bedding, but in the component parts of the sandstone itself. There is no gravel or coarse sand in it; it is all an extremely fine, angular sand.

We would like to hear from Mr. Van Arsdale concerning the reduction of these ores.

Mr. Van Arsdale.—The first time this matter was brought to my attention was when Dr. Douglas said he would like me to find out all about radium. We started some experiments, but I think it will be some years yet before we carry out his order.

The work we have done on the extraction of radium started several years ago, due to the personal and philanthropic interest Dr. Douglas felt in the subject. At that time very little general information was available. Pitchblende was not seriously considered by us as a source of radium, and after a visit to Dr. Hess of the Survey, who very kindly furnished us with a considerable amount of information, we turned our attention to carnotite. The object of our experiments was to devise, if possible, a method of making radium at a lower cost than the market price at that time.

Naturally, since we were informed that the amount of high-grade carnotite was limited, our first experiments were on concentrating some samples of low-grade material. We were

uncertain at the start of the work whether, in a mechanical concentrating scheme, the radium would follow the mineral or not. The tests showed, however, that a concentration of the radium as well as of the other mineral constituents took place.

The method adopted was the obvious one that has been used by others, namely, to crush the ore sufficiently to free the carnotite from the sandstone grains and then to separate the resulting slimes by agitation and decantation from the sands. The ore first treated was from Colorado, and contained about 1.25% U_3O_8; our tests showed a concentration of about 5 into 1, with an extraction of probably about 80% of the radium. Our early tests were made by photographic methods alone, so that the above percentage is only approximate, but I believe is nearly correct.

We then started some extraction experiments. There were a number of possible methods of treating the ore, but extraction with an acid solvent seemed simplest.

Since radium is very similar to barium, any chemical method suited to the extraction of barium would be expected to remove radium also. Fairly good results were obtained in small laboratory tests by the use of hydrochloric acid as a solvent. In all of the ores tested we found appreciable amounts of barium, although the amount was quite variable. We found that the barium was soluble in the acid used, and that the washed tailings apparently carried very little radium.

Tests on a scale of about 100 lb. a day were then arranged for, and the results from this work being encouraging, plans were then made and apparatus secured for a larger plant.

Tests up to this point had given us extractions of 80 to 90% of the radium contents of the ore, checked by samples tested by Prof. Boltwood of Yale, so that we felt reasonably safe in going ahead. Our large-scale work was disappointing, however, since the final amount of radium secured was only about 30% of the estimated contents of the ore. This larger work was not done under my personal supervision and there were some unexplained losses of radium, so that I feel that, properly carried on, this method is still capable of yielding, say, 80% of the radium contents of an ordinary carnotite. Further tests will be made and the question definitely settled.

Our work was much complicated by the necessity of making a special grade of uranium and vanadium product, and I am inclined to think that, except under special conditions and when there is a ready market for these products at a good price, it will pay better to treat the ores simply for their radium contents.

From a carload of ore we obtained between 50 and 60 mg. of radium, which was barely 30% of the amount present; deducting the cost of plant equipment, which should not be charged as a production cost, and also deducting the cost of experimenting on the uranium product, which, of course, would not be repeated in future work, the actual cost of the radium made, including everything else and crediting the returns from the sale of uranium and vanadium, was $78 per mg. of pure radium bromide. Naturally, if our extractions had been as high as expected, about 80%, the cost would have been correspondingly lower, and I believe that radium can be made by this method in the East, from 1 to 1½% carnotite ores, under proper conditions, at a cost not to exceed $30 per mg. of pure bromide, and probably somewhat less. This, of course, assumes approximately the present price of carnotite ore.

I have since confirmed my earlier tests, and it is possible that something may still be done with the method, although the large-scale test was not a commercial success, due to the unexplained losses.

We, of course, recognize that where sulphates are present in an ore, or in the water or acid used, the solubility of the radium is diminished, but in any case the radium will be either in solution, or left with the sands as insoluble sulphate. If the latter, the separation of any considerable amount is a comparatively simple matter.

I was much interested in finding, after I had done considerable experimenting on carnotites, that Dr. A. H. Phillips, of Princeton University, was one of the earliest workers on carnotite ores if not the earliest, in this country and that the methods which he had thoroughly tested for extracting radium were substantially the same as we adopted. Credit should be given to Dr. Phillips for this pioneer work on the subject, which I do not think has been generally known.

Quite recently I have found an interesting new method of precipitating uranium and vanadium and while much remains to be done to prove its value, I believe that results will come from its use. The extraction of radium itself is comparatively a simple matter, and most of the complication in the treatment of carnotite ores comes from the great difficulty in separating and preparing uranium and vanadium in forms sufficiently pure to be readily salable.

It seems probable to me that the eventual method by which radium will certainly some day be produced at a cost that will make its use generally possible, will have to be a much simpler method than any heretofore described. Such a method will

permit the considerable amounts of low-grade ores to be beneficiated, and will probably be preceded by concentration.

The Chairman.—As I understand it, the Colorado ores average from 1.8 to 2.5% of uranium oxide. Is there much ore of lower grade than that which it would pay to concentrate?

Mr. Hess.—A great deal. I believe the coming feature in carnotite mining will be the concentration of low-grade ores by cheap methods. Such process has been worked out, and I look for a great increase of mining by concentration of low-grade ores on the ground, providing the demand continues.

The Chairman.—The actual cost of mining, as I understand it, is about $32 a ton. The expenses after that, for special sacks, packing on burros down to the railroad, etc., amount to more than that sum, so the actual cost of the ore is between $75 and $80 a ton delivered to the railroad.

We shall now have the pleasure of listening to Dr. J. A. Holmes, Director of the U. S. Bureau of Mines.

J. A. Holmes.—In 1904, during the St. Louis Exhibition, we became interested in the radium question, and some of you may remember that at the exhibit in the Mines Building we had a small radium exhibit.

About two years ago, a laboratory was established in Denver to investigate the general question of the rarer metals and minerals. Those in charge of the investigation came in touch with the mining of carnotite ore and found that sometimes ten tons of inferior material was mined to one that was really rich enough to ship. It was understood that there was also a considerable waste in methods of extraction. In addition a general interest in radium was aroused, and the need of Government hospitals for a supply of radium was made known. In this way the Bureau of Mines came in close touch with the radium situation about a year and a half ago. The great importance of the subject led us to go into the question more fully.

You realize that in a certain capacity we act for the Government in the same way as a private engineer acts for a private corporation. When the Government hospitals became interested in the radium situation, and wanted to buy radium, they met with two difficulties: First, the very high cost of radium, and secondly, the difficulty of finding anywhere an available supply. One person who tried to buy at least one gram in Austria was unable to buy it at any price for immediate delivery. Our inquiries were met with answers of about $140,000 per gram

radium metal in the form of radium bromide, of ordinary purity, and for a higher degree of purity we were asked to pay $180,000 a gram. That was beyond the purse of the Government hospitals. As regards the production of ore in this country, we found, as Mr. Hess told you, that during 1912 ore containing about 28 tons of uranium oxide was mined and shipped abroad, and that during the past year a little more than 2,100 tons of ore carrying some 38 tons of uranium oxide was produced and about one-half of it was shipped abroad. The other half is being treated by two radium plants in the United States, one near Pittsburgh and the other near Philadelphia. Both of them claim to be extracting radium. The larger part of the production for 1914 is already pledged in foreign markets. As far as we could determine, there are three plants in Europe using American carnotite, one in Liverpool and the other two in France. The recent reported development of large ore bodies in Portugal has led our correspondents to think that the demand for ores for the French plant is likely to be reduced to a much smaller quantity in the near future.

At no time has anyone connected with the Bureau of Mines made any plans for going into the general radium business, but inasmuch as in certain matters we have to act as experts for the Government, the question was put up to us, whether we could produce radium for use in the Government hospitals at a cost less than the price at which it can be bought. In answer to the question we must, of course, bear in mind that we cannot always depend upon laboratory results in determining what can be done on a commercial scale. Our chemists have been working on the extraction of radium and they think they have developed a method by which they can extract radium at a cost very much less than the price at which it is sold at the present time. I do not feel quite at liberty to go into details with reference to the processes themselves. Nevertheless, I am quite sure that the gentleman who preceded me has found that they have no secrets from him or anybody in the Government service who is directly interested. Naturally, however, they feel some delicacy at making public any statements as to what they expect to accomplish in connection with the actual extraction of radium. The plant being erected by the National Radium Institute is now just starting to do practical work at Denver.

There was another reason which made us willing to undertake the extraction of radium, and that is, so far as we could learn, all of the radium extraction plants are using processes which they are unwilling to make public. We of course feel that secrecy is permissible in ordinary commercial operations,

but we also felt that if anything could be done in connection with the operation of the Government hospitals to make public a process of extraction of radium from ores belonging to the people, it ought to be done. As soon as we get definite results from this plant at Denver, we shall publish them at once, and the only reason I am not saying anything about the actual processes is that we are anxious to prove on a manufacturing scale that they are practical before we make them public. The results seemingly are very satisfactory.

Mr. Liddell.—One feature of this Governmental investigation does not particularly appeal to me, and I would like to hear a little further justification of it. These radium companies have spent large amounts of money as pioneers in the business. Why should the Government then investigate this work and make the process public? Why should the Government not go into the nickel business, let us say, and make those processes public? Does not the pioneer in an art deserve consideration for investing his money and establishing the industry?

Mr. Huntoon.—I would like to ask Dr. Holmes about the effect of radium on the tissue adjacent to a cancer?

Dr. Holmes.—Answering the second question first—there are three different kinds of rays given off by the radium, the alpha, beta, and gamma rays. There is perhaps a slight difference of opinion as to whether the beta or gamma rays do most good. It is generally agreed that the gamma rays are the active curative agent, although it may be that induced beta rays are also effective. The alpha rays do most of the burning, but these are screened off in practice. While temporary burns may occur they are usually easily healed although their severity varies in different parts of the body.

In reference to the first question, I do not know that I need answer it at all from an academic standpoint. From my point of view, there is a reason for producing a material which has a life-saving application, that would not appeal to me at all in ordinary commercial operations. If in the abstract there is a difference between the nickel and copper industries and an industry which I am led to believe may be largely instrumental in saving life, I will put the difference on that ground. In this case there is not only the difficulty of getting at any price the quantity of radium desired, but on the other hand, of having to pay for it what we believe to be an exorbitant monopolistic price.

The Chairman.—Can you give us any approximate figures as to what the probable cost of producing a gram of radium would be, or is now? What is the difference between the quoted price and the real cost of production?

Dr. Holmes.—I can give you a general estimate. So far as our observation goes, we believe we would be able to produce radium at certainly less than one-half of the advertised price, and, we believe, at nearer one-third of it.

In some further discussion by the chairman and Dr. Baskerville the latter indicated some physical methods for the production of the gamma rays, the accomplishment of which would materially influence the price at which radium preparations were quoted, since radium is useful apparently only insofar as it will produce these rays.

He also brought out the factors influencing the reduction in price of chemicals with increased demand for them, using as an illustration thorium oxide and the Welsbach mantle.

After further remarks by Mr. Hess and Dr. Holmes, Mr. Huntoon moved that the members of the Society express their thanks to the gentlemen who had addressed the meeting, which motion was seconded and unanimously carried.

The meeting adjourned at 10:55 p. m.

D. M. Liddell,
Secretary of Section.

COMMUNICATIONS.

B. B. Lawrence.—I wish that the Society might have a discussion upon the subject: "Should the Under Graduates in Our Universities, Taking Engineering Courses, be Required to Have Previous Academic Training as in the Case in Law and Medicine?" In other words, will it contribute to the benefit of the professions of Engineering that our leading universities should make their courses in Engineering post-graduate courses? This subject interests me very much, and I am very anxious to have it discussed by engineers—particularly those who have been in the field for a number of years. May we not have such a discussion?

[Members of the Society are invited to communicate to the Secretary their views upon the subject presented by Mr. Lawrence.—W. R. Ingalls, *Secretary.*]

PERSONALS.

Lawrence Addicks has left for Douglas, Ariz., to take charge of the research work of Phelps, Dodge & Co., in connection with the leaching experiments initiated by G. D. Van Arsdale.

Sydney H. Ball sailed from New York on May 5 and will spend most of the summer in Greenland, making an examination of the mineral deposits of the west coast.

Percy E. Barbour, manager of the Uwarra Mining Co., Candor, N. C., has resigned his position, his resignation taking effect early in June.

J. M. Boutwell has finished his detailed geological survey of the Old Dominion property at Globe, and has returned to his office at Santa Barbara to prepare the report.

George M. Colvocoresses has completed installation of a flotation plant at the smelter at Humboldt, Arizona, and will return to the East soon.

N. H. Darton, of the United States Geological Survey, will spend June to October in the Southwest obtaining data for a description of the geology and other features of interest along the line of the Santa Fe Railroad, to be published as a Survey bulletin for use of travelers to the Panama-Pacific Exposition.

H. W. Hardinge is planning to sail for Alaska on June 25 to conduct a test in the plant of the Alaska-Treadwell Mining Co. of a Hardinge ball mill vs. stamps.

Bradley Stoughton sailed from New York April 27 for a vacation in France and Spain.

A. N. Winchell, of the University of Wisconsin, has returned from a visit to the Missouri School of Mines, the University of Kansas, the Agricultural College of Iowa and the University of Illinois. At each institution he delivered two lectures, one upon the "Mining Geology of the Butte District," and the other upon the "Origin of the Butte Ore Deposits."

CHANGES IN ADDRESS.

Addicks, Lawrence .....Douglas, Ariz.
Barbour, P. E.....887 Middle St., Bath, Me.
Brayton, Corey C.....433 California St., San Francisco, Calif.
Channing, J. Parke.....61 Broadway, New York
Hixon, H. W.....Box 11, Worthington, Ont.
Lyon, D. A..Dept. of Metallurgical Research, University Utah, Salt Lake City, Utah
Shaw, S. F.....136 Liberty St., New York
Sussman, Otto.....61 Broadway, New York

MEMBERS ELECTED IN MAY.

Knox, Newton Booth..9 Upper Hamilton Terrace, London, Eng.
Consulting Engineer.

Ludlow, Edwin .....Lansford, Penn.
Vice-President, Lehigh Coal & Navigation Co.

Maclennan, Francis William.....Miami, Ariz.
Asst. Manager, Miami Copper Co.

Rogers, Edwin M.....32 Broadway, New York
Consulting Engineer.

Mining and Metallurgical Society *of* America

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ANNOUNCEMENTS.

San Francisco Section.—A delayed report of the meeting of the San Francisco section held on Feb. 12 will be published in bulletin No. 74.

Subjects for Discussion.—The Secretary has sent to all members of the Society the following letter:

During the last season there were several subjects discussed by the Mining and Metallurgical Society which excited a great deal of interest, these being technical subjects engaging general attention at the moment. Especially noteworthy among them were the discussions on the hydrometallurgy of copper and the flotation process. In the meetings of the New York section where these subjects were discussed there was a frank, intimate and illuminating exchange of opinion such as does not often occur in meetings of a technical society.

It is contemplated to have further discussion of the same character during the coming season, and for the benefit of members who are unable to attend the meetings, we shall try to publish better reports in the bulletin. It will be helpful to the council in arranging plans if each member of the Society will offer suggestions as to the subjects that may be usefully taken up for such discussion. I shall be obliged if you will communicate to me your views respecting this.

This letter was issued with a view to obtaining the co-operation of all members of the Society in making plans for the meetings of 1914-1915.

Annual Medal.—In accordance with paragraph 3 of the rules for award of annual medal, the Secretary has sent to all members of the Society a communication on this subject. The rules for award of the annual medal may be found on page xiii of the pamphlet containing constitution, by-laws, etc. The third paragraph is as follows:

"Six months before the award the Secretary shall send a circular letter to all members requesting suggestions as to the specific object for which the medal shall be awarded and asking for the nomination of candidates on a form provided for the purpose, such nominations to be accompanied by a full statement of the claims of the candidates for consideration. These nominations shall not be confined to members of the Society and may include other nationalities than our own."

The annual medal of 1913 was awarded for "Distinguished Contributions to the Literature of Mining." In taking the first step toward the award of the medal of 1915, members of the Society should express themselves respecting the subject that they think most desirable for the award and also nominate a candidate coming within the scope of that subject. It will be helpful if every member of the Society will communicate to the Secretary his own expression of opinion, on the blank form that has been provided and will do so promptly.

W. R. INGALLS,

Secretary.

THE MEDAL PRESENTATION

The dinner of the Society at which its first gold medal was presented to Herbert C. Hoover and Lou Henry Hoover, his wife, took place at the Biltmore Hotel, in New York, on Mar. 9. It was a noteworthy event, attended by just an even 100 persons, including members and their guests. The presence of ladies added much brilliancy to the occasion and was highly appropriate in view of the fact that one of the recipients of the Society's medal was a woman.

The members and guests present at the dinner were the following:

Miss Alexander, Mr. and Mrs. Percy E. Barbour, Mr. and Mrs. S. H. Ball, L. W. Bates, L. W. Bates, Jr., W. N. Best, Dr. E. Beck, Prof. Wm. Campbell, Mr. and Mrs. W. B. Cogswell, W. C. Cuntz, John A. Church, R. Dana, W. P. Dunham, Mr. and Mrs. L. D. Dudefret, Mr. and Mrs. W. B. Devereaux, Mr. and Mrs. Arthur S. Dwight, J. V. N. Dorr, Howard W. Dubois, Mr. and Mrs. Karl Eilers, Mr. and Mrs. Byron E. Eldred, A. J. Eveland, Mr. and Mrs. J. R. Finlay, Dr. A. Grothe, George H. Garrey, J. R. Gruver, Mr. and Mrs. H. C. Hoover, Mr. Hewes, J. G. Hastings, J. D. Hawkins, Dr. J. A. Holmes, L. D. Huntoon, Mr. and Mrs. W. R. Ingalls, Mr. and Mrs. Hennen Jennings, Mr. and Mrs. Sidney J. Jennings, W. McA. Johnson, Mr. and Mrs. Jas. F. Kemp, Geo. F. Kunz, Mrs. Chas. Kirchhoff, Robert Linton, Mr. and Mrs. D. M. Liddell, Mr. and Mrs. W. Lindgren, W. F. Laun, N. B. McKelvie, S. T. Mauser, Mr. and Mrs. W. W. Mein, J. W. Mercer, Mr. and Mrs. Willard S. Morse, Mrs. H. S. Munroe, Mr. and Mrs. W. A. Pomeroy, F. E. Pierce, Mr. and Mrs. H. A. Prosser, J. W. Reno, D. M. Riordan, Chas. F. Rand, Miss Rand, Mr. and Mrs. T. T. Read, E. Gybbon Spilsbury, Miss Beulah Spilsbury, Geo. C. Stone, Miss Stone, Mr. and Mrs. Bradley Stoughton, Mr. and Mrs. W. G. Sharp, Mr. and Mrs. Thos. B. Stearns, Dr. and Mrs. Otto Sussman, Dr. Joseph Struthers, S. W. Traylor, Mr. and Mrs. B. F. Tillson, H. A. J. Wilkens and two guests, W. Y. Westervelt, Arthur L. Walker.

The Medal Presentation Dinner, Biltmore Hotel, March 9, 1914.

The method adopted by the Mining & Metallurgical Society in awarding its medal is rather unusual and results in an honor which must be especially prized by reason of its spontaneousness. In brief, one of the first steps is a vote by the whole membership of the Society as to whom it considers honor especially to be due. Of course, such a procedure is possible only in a society relatively small in number, with a well developed system for the conduction of letter ballots. The council of the Society first selects a subject, within the limits of which the award of its next medal is to be made. The subject selected for the medal of 1914 was "Distinguished contributions to the literature of mining." The members of the Society express their individual ideas as to who deserves special recognition in that subject, a direct primary being conducted, so to speak. The medal committee makes two nominations out of the names suggested by the membership and the council of the Society votes upon those nominees. The expression of opinion by the membership, last fall, showed a large majority in favor of the Hoovers, and their election by the council was all but unanimous.

H. C. Hoover has not been a prolific contributor to the literature of mining, but his contributions have been of the highest value. He has contributed generously to the engineering periodicals; has published a wonderfully concise, yet wonderfully comprehensive treatise on "The Principles of Mining"; and last of all, with the assistance of Mrs. Hoover, made a translation of Agricola's "De Re Metallica."

In all of Mr. Hoover's literary work, Mrs. Hoover has been an important collaborator. In the preparation of his "Principles of Mining," she revised the manuscript, read the proofs and saw the work through the press, remaining in New York for that purpose after Mr. Hoover had been called away. In the translation of Agricola, her collaboration was more important. She accompanied Mr. Hoover in his travels of investigation, joined in his studies of the history of mining, and bore the brunt of the translation of corrupt, mediæval Latin into fluent and accurate English.

The dinner committee prepared a unique souvenir of the occasion, a pamphlet comprising reproductions of some of the engravings in Agricola, with captions applying these to the professional work and experiences of the Hoovers. The antique type and spelling contributed the right flavor. The souvenir also contained an engraving of the medal. The design was greatly admired. The idea is knowledge, typified as a beautiful

woman holding a miner's light, breaking through the barrier rock of Ignorance.

Prof. J. F. Kemp, president of the Society, presided at the dinner. The speaking after dinner was limited in a very gratifying way and was unusual in character. Sidney J. Jennings responded to the toast of "The Ladies." Thomas B. Stearns, of Denver, Colo., spoke for "The West," and conveyed the felicitations of the members and professional men in that great region.

The addresses of Professor Kemp on presenting the medal and of Mr. Hoover on receiving it were as follows:

Professor Kemp:—This is a very happy occasion. It is always a happy occasion when the members of a profession meet to recognize good work. We of the East have intercepted two of the West on their way to the farther East. We welcome the "Impresario" and the "Impresaria" of that sweet singer at the end of the Middle Ages, Georgius Agricola. Agricola was born in 1493. You may disagree with me about placing him at the close of the Middle Ages. Some think this period ended with the invention of printing about 1450; others with the fall of Constantinople, 1453; others with the discovery of America, 1492; and still others with the crisis of the Reformation, about 1520. But we miners know that, for us, the Middle Ages ended and the Modern Age began with the birth of Agricola. We are somewhat like the late Father Ducey, a greatly esteemed and beloved priest, who some years ago was in charge of a church on one of the east and west streets, south of where we are tonight. His church had its long axis running north and south, with the altar at the north. "How is this, Father Ducey," said a friend one day; "how do you justify the altar at the north, when it is the custom of the Catholic Church to have the altar at the east?" "Sir," said the clergyman with a twinkle in his eye, "Sir, where the altar is, that is east."

The first book of the twelve constituting the *De Re Metallica,* is a defense of the miners' calling against the aspersions and criticisms cast upon it, from the times of the early Greek writers down to Agricola's own day. Many had extolled the work of the farmer, and depreciated the work of the miner. While the former tilled the soil and drew from it ever renewed crops, the latter turned the valleys and mountains into barren wastes and lived but to destroy. Agricola writes, however, a full and satisfactory defense, a sort of *apologia pro sua vita,* and we cannot but remark the coincidence that one whose *nom de plume* was "Farmer" should present a brief for the miner.

It is very appropriate that the Mining & Metallurgical Society should award its medal in part to the "Impresario" who signs himself on the title page first as a member of the American Institute of Mining Engineers, and second as a member of the Mining & Metallurgical Society of America. The only reason that the "Impresaria" does not sign herself in the same way is that we have not yet found for engineering societies, a word which corresponds to co-education in the universities. We are thankful, however, that no provision of our constitution prevents us from recognizing the distinguished services of a lady by asking her to dine with us and by improving the occasion to show our indebtedness in other ways.

This dinner has the happy quality of not being given to *man* alone. He recognizes in this feature the commendable state of affairs toward which we are more and more tending in that the partnership, which we have been taught was instituted as a means of setting the solitary in families, is becoming one of good comrades, chums, and of association, not alone in work, but in those relaxations and hobbies which we all need as a foil and a refreshment after the labors of the day. While it is unusual, although not unprecedented, to find an engineer turning to the translation of ancient Latin texts as his recreation, it is, I think, unique to find his helpmeet sharing his enthusiasms in this particular. Nevertheless, we recognize the propriety of it all, by placing at the outset of the dinner, instead of at its end, the toast of "The Ladies" to which Mr. Sidney J. Jennings will respond.

[Mr. T. B. Stearns was subsequently introduced to speak for the Western portion of the country. On the conclusion of his address, the President of the Society awarded the medal with the following remarks:]

The council determined this year to bestow the first award of the medal of the Mining & Metallurgical Society of America for distinguished contributions to the literature of mining. It was their desire to emphasize especially the scientific, the ideal, and the unselfish sides of service. This desire found its peculiarly appropriate fruition in the award, by a general vote, of the medal to Herbert Clark Hoover and Lou Henry Hoover for making known to us all the great author, who wrote nearly four hundred years ago upon the subjects which we all love the best.

The medal shows Science, or Truth, in the form of a beautiful woman, with a miner's light in her right hand breaking a way through Ignorance, typified by the rock which impedes the miner's advance. The work, whose completion the medal is intended to crown, is one of a peculiarly unselfish and idealistic

character. It is an interesting and emphatic answer to those who think that pure and applied science are far apart, or that one immersed in the heavy cares of an onerous profession forgets thereby the purely cultural subjects of his earlier education.

We find these two graduates of the youngest of our great universities holding fast the classics of their earlier years and applying them in the translation of a masterpiece. Not only this, but we note that they become so well-versed and critical with regard to the literary style of the ancients, and of the writers of the Middle Ages, as to detect in Agricola himself his occasional lapses from the purely classical form of expression. We must conclude that the classics with them, as is stated in a little Latin phrase regarding mineralogy, on the title page of the older editions of Dana's great treatise, are "studies which accompany us on our travels and on our vacations."[1]

We may make a further comment along these same lines. Two other members of our profession, Horace V. Winchell and E. P. Mathewson in former years undertook the same translation but were finally deterred by the obscurity of the old descriptive terms. Indeed if you imagine caps, props, bents, stulls, winzes, etc., described in Latin in the first half of the fifteen hundreds you can readily see they are not easy always to recognize and translate. But the interest was shown, and our only reasonable and proper conclusion is as follows: Not only is the practice of applied science not inharmonious with cultural subjects; but thorough masters of any branch of engineering desire to know it no less in its historical setting than in its modern accomplishments; and are no less sensible of our debt to the men of the past, than to our contemporaries.

We can hardly speak of Agricola's "Metallic Wealth," applying as it of course practically does to Central Europe, without being reminded of J. D. Whitney's "Metallic Wealth of the United States." The titles are so similar that the former must have suggested the latter. While Agricola's work is more general and has been longer and more widely read, Whitney's was, nevertheless, of great influence, and was prepared as a message to his countrymen, at the time profoundly unfamiliar with the whole subject of mining. Whitney was an apostle to the ignorant; Agricola was the recorder of the experience and practice of centuries. Yet Whitney's work may be taken as one of the results of Agricola's example. The instance is the more notable because in practice and development the great fruition of Agri-

[1]*Haec studia nobiscum perigrinantur . . . . rusticantur.*

cola's teaching has been on this side of the Atlantic, and in lands of which he knew little or nothing.

In some other respects the New World has not been unmindful. The Geological Survey of Mexico has a beautiful home on the Avenida del Ciprés, facing a little park in the City of Mexico. The first things that strike you as you enter its spacious hallway are two beautiful stained-glass windows, reproductions of two full-page plates from Agricola's *De Re Metallica.*

Doubtless many instructors in this country have for years spoken of Agricola, the "Father of Mineralogy" to their classes. I have been accustomed for twenty years to show to my older students the *De Re Metallica* and to have them at least look at the pictures even if they could not read the text. For ten or fifteen years his face has looked down upon each day's work done in the laboratory. All this is a trifle compared to what we may now command. We must all rejoice that Agricola's wisdom, his quaint every-day philosophy and his descriptions of processes almost three centuries before the atomic theory of matter was grasped, are now accessible to every English-reading student.

For this great service to the profession and in the name of the Mining & Metallurgical Society of America, I have the honor to hand to you, Herbert Clark Hoover, and to you, Lou Henry Hoover, jointly, the medal of the Society in its first award.

Mr. Hoover.—I wish first to express to you the pleasure that both my wife and myself feel at the honor the Society has paid us. We appreciate that this is a double honor, not only in that this is the first medal conferred by the Society, but also in your assurance that it was voted unanimously by the members. In the accomplishment of any task there are many pleasures, and not the least is the approval of its merit by one's own profession. When all is said and done, the esteem that counts most is that coming from those who are experts in that work.

The years my wife and I spent together on rambles of exploration into the history of our profession, and in the translation of *De Re Metallica* have carried in themselves, from day to day, sufficient reward for any labors which the work has entailed. These explorations have been made possible by Mrs. Hoover's linguistic abilities, and if the work meets your approval, as this occasion proves, then the major indebtedness must be to her for her patience in the drudgery of mediæval Latin, German, and French grammar and syntax.

For many years I have been impressed with the general assumption by the members of the engineering profession that

theirs is the youngest of all the great professions; that, as a profession, it was the creature of the last century; that it is without a long background of literature, history, tradition, and achievement. More especially that its members have contributed but little outside their own work to the intellectual development of the race; that they have had but little part in the upward struggle of humanity towards legal and intellectual freedom.

It is a fact, however, that the various branches of the engineering profession so prominent nowadays—or even predominant—in the world's work, have, and more especially the miners, contributed their due share to all sides of the world's progress at all times.

The earliest possible excursion into this byway of history raises an interesting consideration which I have not time here to pursue beyond its mere mention. I would recall to you that the very beginnings of human beliefs are populated with metallurgic personalities. Unless we consider war a profession, we are almost alone of all professions in possessing a place among the gods on Mount Olympus; nor was Vulcan the least among the gods. There are also the mysteries of Samothrace, the Dactyles, the Cabires, the Corybantes, the Telchines, and the more familiar Cadmus, not to mention Ptah of the Egyptians, and Tubal Cain of the Hebrews. They all immortalize the importance of our arts, and gratitude for them, at the first glimmer of human enlightenment.

Coming now to authentic history, I may recall to you that Themistocles and Thucydides were miners, and I need but mention the Battle of Salamis to emphasize the miner's contribution to the preservation of civilization. Here the Asiatic was turned back from his attempt to subdue the West, wherein his success must have engulfed the civilization of Greece. It was the miners of Laurium who furnished the funds which built the Athenian fleet; it was a miner who directed the battle, and miners who helped in the fight.

Of the tangible character and doings of our early brothers in historic times we get only occasional sidelights. That Egyptian inscription of 50 centuries ago, "I was the servant of the King. I worked the mines of Nubia," smacks of professional pride. If type of metaphor stamps the calling of men, then we can claim Homer, Jeremiah, and Virgil. Vulcan's workshop was described by no amateur, and as to the Golden Fleece, is it not an epic of the labors of many of our brothers?

Jeremiah uses over a score of technical metaphors, and his generally pessimistic and peevish mind further confirms the

hypothesis that he was a metallurgist by calling. At one place he states: "They are all brass and iron, they are corruptors, the bellows are burned and the lead is consumed in the fire. The founder melteth in vain, reprobate silver shall men call them." Here is anguish over metallurgic failure which could be epitomized only by one of the calling.

To mention a few other figures of history, Philip of Macedon was a miner and founded his family and fortune on mines. The Athenian Nicias, the son of Niceratus, was a well known mine operator, but his attitude toward fellow professionals leaves something to be desired, for it is recorded that he bought a mine overseer for a talent of silver. While this price—equivalent to $40,000 in modern purchasing value—showed an early appreciation of proper fees, yet the buying of him lacked the delicacy of approach to professional engagements that we should have liked to find. There was also Diphilos, an engineer who was beheaded by Lycurgus for directing the robbing of mine pillars. I trust, in calling attention to this precedent, I shall cause no embarrassment to my Pennsylvania friends.

Demosthenes was on the borderland of our profession—he was a mining lawyer. Some of his earliest recorded orations before the Athenian Senate were delivered as counsel in mining cases. Theophrastus, who succeeded Aristotle as head of the Peripatetics, was a mineralogist. Theophrastus was the first author to assert that minerals propagate themselves and grow, and therefore he was the founder of the school of secondary enrichment.

Hannibal was a mining engineer and the son of a miner. Our confidence, however, in his technical abilities is a little dampened when we hear it asserted that in his long uphill fight against the Romans, he used vinegar to quench his fire-breaking of the Alpine roads. The frightened Romans, however, who record this, may have had the same illusions as to his engineering abilities that the news writers have of some of our modern colleagues.

There is also a Praefectus Metallorum who, in time of rebellion or strike of his miners, confined them underground and traded them food and water for ore. I have felt that he may have perhaps been worried out of the usual humane paths of our profession by the demands of some Roman Federation of Miners.

But time compels me to abandon the pursuit of these dim shadows of our pre-Christian forefathers in labor.

I need not repeat to you that after Roman times an almost

complete eclipse occurred in all civilization and industry. Only after the lapse of centuries of historic darkness does the European world find itself, at the break of dawn, completely enthralled by the superstition of the Church and by the arms of the Feudal System. The masses were enslaved to the soil; the skilled workers were held rigorously to their hearthstones by primogeniture in calling; and the learned professions, except theology of the orthodox order, were held as heretical or dangerous to the state.

It is at this stage in the world's history that the miner performed what is to me the most impressive service that any calling has done for humanity, for it was the miners who rekindled the light of liberty which ended this darkest period of human history. Long before the awakening of learning, and long before the time of Agricola, the miners of Northern Europe had broken down the universal tyranny of feudalism. Earlier than the 10th century they had demanded and had been granted the free government of their own communities and industry; they had established their own officials and courts. The free mining cities of Saxony and Bohemia, the self-governing communities of Cornwall, Devon, the Forests of Dean and Mendip, and the High Peak of Derbyshire had blazed the way to representative government long before the Mother of Parliaments sat at Westminster. They even led the way for the free merchant cities of the Baltic and England, and soon after the arrival of the Normans, we find in English history references to the "miner's right" to their "ancient liberties" and "customs," terms resonant of independence.

This fine spirit of independence seems to me to be a concomitant of the miner's calling, for not only do we discover it in all those times, but the life of our mining camps of the last ten decades is replete with it. None but men of intelligence and courage can serve in its ranks. Its daily work and daily experience are pregnant with enterprise and adventure. There is yet another characteristic of the miner which, while not so evident in these days, yet stands out vividly enough in the past. The daily invasion into the unknown earth, the dead darkness in which his lamps serve to distort every shape, the uncanny noises of strained rocks, the approach of danger and death without warning, the sudden vanishing and sudden appearance of good fortune, have colored the miner's mind with distinct mysticism, and fallowed the field for religious fervor. But, not less, have all these experiences developed in his character courage, idealism, and self-sacrifice.

It was this spirit of mysticism, of courage, of independence,

this free thinking and free governing in the free mining communities of Saxony which gave birth to the soul of Martin Luther. It was the miners of Saxony who rocked the cradle of the Reformation and it was the miners like Fabricius, and sons of miners, who formed the band who supported his life work. In this connection, I should not fail to mention an engineer nearer to our own times—Swedenborg. Of the same type of character was Georgius Agricola. Agricola was not a narrow slave of his profession. He was a man of deeply religious and courageous nature, the first citizen of his city, the distinguished servant of the state.

Aside from his great inventory of the professional stores of learning in *De Re Metallica,* we should all know that in the history of science and thought, it was Agricola who laid the first stone in the foundation of the modern structure of science. His long overlooked *De Ortu et Causis* is not only the first work on geology and ore deposits, but was the first production of science built upon deductions from observed natural phenomena. It was the first break from the dry scholasticism of the Middle Ages.

I will not dilate on *De Re Metallica,* for the book itself is its own recommendation. That it had an untold influence on the mining world is amply evidenced by the fact that it passed at least ten editions in three languages, and maintained its position as the text book of the profession for nearly two centuries. Nothing could bear higher testimony to its esteem and usefulness than that it was chained in iron bindings in the town halls, in order that the miners might consult it at will.

To me, one of the most interesting of Agricola's themes is his vigorous support of his profession. Despite the note of liberty first sounded by the miners of Europe, or perhaps because of it, the miners were not free from constant criticism and assault from the clergy and the scholastic classes, nor is our profession still free from occasional necessity to defend its right to esteem. It is now nearly four centuries since Agricola wrote: "Inasmuch as the chief callings are those of money-lender, the soldier, the merchant, the farmer, and the miner, I say, inasmuch as usury is odious while the spoil cruelly captured from the possessions of the people innocent of wrong is wicked in the sight of God and man, and inasmuch as the calling of the miner excels in honor and dignity that of the merchant trading for lucre, while it is not less noble, though far more profitable, than agriculture, who can fail to realize that mining is a calling of peculiar dignity?"

Nor do we believe that the influence of his book is yet

over. In arranging its translation, annotation, and publication, we had some fears that our brothers in engineering would consider it a passing book, devoid of practical hints to our profession, and thus of interest only as a recital of old and curious methods. But the honor which you do us tonight convinces us that you see in this publication the underlying hope which we have had; that is, a faith that it would recall to our profession the long service that our folk have been to humanity, and that its production would stimulate a pride of our calling, in its history and traditions, and make for its ideals.

Our professional ideals have not hitherto received that stimulus from our history which they might have had. From the ideals of any profession must arise the real service which that profession and its members will perform to the community and to the race. Ideals are the resultant of forces, gathered from morality, history, and tradition. We stimulate our racial and national ideals and our national pride by appeal to the character and deeds of our ancestors. It is by the preservation of the records of our great men and their deeds that history finds its justification in our daily life. None will deny that the monuments of our history contribute to our citizenship, and no less should the monuments of our profession contribute to our calling.

If in making *De Re Metallica* and its historical annotations available to our fellow professionals we shall have contributed one shadow towards forming the background of professional tradition and pride, we will have performed a service worth a thousand fold of our effort.

PERSONALS

Ralph Arnold is to give a series of lectures at the Throop Polytechnic Institute, Pasadena, Calif., where a course on petroleum has been started.

F. G. Cottrell gave a lecture on his process of smoke control before the Utah Society of Engineers on June 10.

At the close of the last term at the Massachusetts Institute of Technology, Prof. R. H. Richards retired from the active work of teaching which he has followed for the last 46 years. He is made professor emeritus. Prof. Richards will spend July and the first part of August visiting mills at Lake Superior, Butte and Anaconda, Wallace, California, Nevada and Utah, with the idea of bringing the data in his books on ore dressing up to date.

He will attend the Salt Lake meeting of the American Institute of Mining Engineers.

A. L. Walker left New York on June 16 for a pleasure trip to Japan and China. Professor Walker expects to stop at Buffalo, Houghton, Great Falls, Anaconda and Butte to see the smelting plants there, and to sail for the Orient on July 6.

CHANGES IN ADDRESS

Mann, Wm. S.....Cisco, Viking Co., Cal.
Gen. Mgr., Viking Min. Assn., Ltd.

Shaw, S. F.....106 E. French Pl., San Antonio, Tex.

MEMBERS ELECTED IN JUNE, 1914

Guess, H. A. .....165 Broadway, New York.
Gen. Mgr., Federal Lead Co., and Consulting Engineer, American Smelting & Refining Co.

LeFevre, Solomon .....Mineville, N. Y.
Consulting Mining Engineer, Witherbee, Sherman & Co.

Pierce, Frederic Emery .....35 Nassau St., New York
Consulting Engineer.

Van Law, Carlos Whitney.....55 Congress St., Boston, Mass.
Mgr. for Mexico, U. S. Smelting, Refining & Mining Co.

COMMUNICATIONS

L. S. Austin.—Replying to Mr. B. B. Lawrence's question as to whether a preliminary course of study, succeeding that of the high school, can be profitably taken before entering on an engineering course of study; I would say that such a course would be of great advantage to a young man qualifying as an engineer, provided such a course were judiciously planned and properly correlated to the engineering course to follow. Aside from its broadening and efficiency-producing effect it would smooth out some of the crudities and imperfections of the high school course, as generally given, often largely so feminine in its aspect, and which, followed by this preliminary college course, would add the necessary masculine tone.

It must not be forgotten that with so large an output of engineers, a young man must be more than ever well trained if he is to succeed. To-day he should not only be a competent engineer, but should have an efficient gift of expression, both in writing a report and in lucidly expressing himself to those who employ him.

Granting that this Society can agree that such a course, as referred to by Mr. Lawrence, is necessary, I would propose the further question:

What would be a judiciously planned course of study in the liberal arts as a preliminary to the regular engineering course of the technical schools?

Mining and Metallurgical Society *of* America

Vol. VII July 31, 1914. No. 7

ANNOUNCEMENTS

New York Section.—The first meeting of the New York section will be at the Engineers' Club, New York, on Sept. 15. The subject of discussion will be announced later.

Annual Medal.—The time for the nominations of candidates for the annual medal of the Society to be awarded in 1915 expires on Sept. 1, or rather at that time the council determines the specific object for which the medal is to be awarded, and refers to a committee of three members, appointed by the President, the names that have been proposed, but there is nothing in the rules to prevent the consideration of nominations received subsequent to Sept. 1. However, it is highly desirable that members shall make their nominations before that date. In this number of the bulletin are printed two communications with respect to this matter. Both call attention to a previous communication from Mr. Knox regarding the rules for the award of the medal. As the rules stand, the membership of the Society has to propose what the subject for the award shall be and make nominations according to that subject. Mr. Knox pointed out that this method is diffuse, leaving the membership considerably at sea, and recommended that the council take more of a leadership and decide in advance upon the subject of award. The communications from Mr. Sharpless and Mr. Spilsbury, printed in this bulletin, take the same position. The previous communication from Mr. Knox was referred to the medal committee, but no action regarding it was taken, perhaps because of the prolonged absence of Professor Munroe who is chairman of that committee. Anyway, the rules for the award of the medal not having been amended by the council, there is nothing to be done at present except to proceed according to them as they stand. There is no reason, however, why each members should not propose several alternative subjects and make a nomination fitting each one. Thus, any member might suggest as subjects "Successful mining administration," "The advancement of the science of mining geology," "The advancement of the art of metallurgy," etc., and propose a name for each subject.

W. R. INGALLS,
Secretary.

MEETINGS OF SECTIONS.

SAN FRANCISCO.

A meeting of the San Francisco section was held in the Engineers' Club, Hotel Sutter, on Thursday evening, Feb. 12, 1914, the following members and guests being present: S. B. Christy, chairman; A. D. Foote, Abbot A. Hanks, E. A. Hersam, H. C. Hoover, A. C. Lawson, C. W. Merrill, F. H. Morley, E. L. Oliver, W. H. Shockley, and Whitman Symmes.

The feature of the meeting was an address by Mr. W. E. Colby on "Early Mining Laws." [It is because of Mr. Colby's important legal engagements in many parts of California for several months subsequent to the meeting that his address has not been published earlier.—Secy.]

On Early Mining Laws.

W. E. Colby.—It is interesting to note first some of the peculiarities of the earliest laws. So far as writers have observed, in very early times no definite measurement of the surface was attempted. It is natural to suppose that when mineral districts were first discovered, and people knew very little about mining, there would not be so great a rush for the regions as occurred, for example, in the early days of California. At that time ground was more abundant than miners, whence it was not necessary definitely to determine the area of mines. They did not work very deep, the question of working another man's mine had not arisen, and, so far as the records show, the size of claims was very indefinite. Another contributory reason probably was a lack of knowledge concerning surveying. It was not until the mining industry had become more advanced that surveying was generally practiced, and mines could be surveyed.

In early times they resorted to very primitive methods for marking out their mines. In the mountains of Bohemia they adopted as a measure the distance a man could shoot an arrow. In a part of Germany they resorted to the *Hammerwurf*, using the heavy hammer employed in mining operations; so far as a man could throw that hammer from the shaft where he was working he was entitled to hold his ground. Another remarkable instance of that practice was found in England, probably having no connection with the German tradition. It was known as the "Hacke's throw," the implement used being the miner's mattock or pick axe; a man had to stand up to his waist in his discovery shaft and throw the mattock along the course of the vein that he was working. The expression, "miner's

pitch," also arose from the throwing of a pick. A great many of these old terms have been brought over, and the influence of early mining tradition is felt even in our time.

In our endeavors to trace certain laws it has been difficult to point to definite evidence as to why certain early laws were adopted. But there is enough to indicate that the general trend of the old laws was influential in the mining development of this country. Again, in other respects we find, running through the laws of Europe and England, peculiarities which seem almost certainly to have caused the adoption of similar laws here. In the first place, definite measurement on the ground followed when mining districts became important. The miners adopted a special size for each district, for each district differed as to the nature and the value of the ground, and definite boundaries were fixed for each claim, outside of which the miner could not go.

In the second place, certain labor had to be performed to maintain one's right to the ground. The miner had to prove good faith by the performance of a certain amount of work. I have collated a few instances, which will indicate how similar some of these provisions were; yet I would not attempt to say that any of them were direct reasons for adopting the annual labor provision in the United States. At one period, in Germanic times, in some cases, a lapse of a year or a year and a day, without working, forfeited the miner's right and made the field free again. In Cornwall, an annual renewing of the boundaries of the claims was essential to a continuance of the owner's rights. At another time in Cornwall, mines that remained unworked for twelve months were declared forfeited. At another time, in a certain portion of Cornwall, annual labor was required to the equivalent of one man's work for three months to prevent the forfeiture of the claim. In France, under the law of 1791, the grantee of a concession who ceased working for one year, without cause approved by the department, forfeited his rights. Going back to Roman times, an inscription has been found stating that a certain amount of work was required to be done annually, and in another case every six months, to keep alive the rights of a miner. Hence we conclude that this requirement of annual labor is undoubtedly of great antiquity.

Further, we find in Germany other provisions governing the acquisition of miners' rights, among which was one requiring the registration or recording of claims. We find that feature handed down through all mining law. After he had made his discovery and had staked out his boundaries, a man must then record his location. That provision was practically uni-

form in all laws. There is a difference in the manner of recording in parts of Europe and in this country. In Europe, to register his claim, a man had to go to some official, the *Bergmeister* or *Bergkmeister* in Germany, the *Barmaster* in Derbyshire, and the *Bourgmestres* in France; this official usually examined the mine, or sent some representative to see that a discovery had actually been made. The claim was then marked out and the official registered in his book the certificate of location, giving the basis of the title.

Other institutions sprang up in Germany, in connection with free mining, some of which have been inherited through Derbyshire, Cornwall and Devon, and so on; one of these is the establishment of a miners' court. It seems strange to me that in early days of California something did not crystallize into the form of a miners' court. In fact, the mining regulations did contain a germ which later might have resulted in the establishment of such a court. There was a tribunal composed of two or three miners, which settled disputes right on the spot and quickly. Some districts had quite an elaborate code for the trial of cases, and permitted an appeal to the Justices' Court. In Germany these courts sprang into existence and had considerable importance. Probably the feudal system had a great deal to do with the establishment of these courts, their purpose being to protect the mine workers from the landlords, the owners of the surface, who controlled the districts in which the mines were situated, to see that no injustice was done to the miner, and to encourage him in his work. Certain royalties were paid to the feudal lords, who naturally wished the royalties to remain as large as possible by protecting the miners. These courts determined all matters relating to the mines themselves, whether a trespass, an action by one miner against another, a lien upon a mine, or anything else connected with the mine. Finally the jurisdiction of these courts became enlarged until, whenever a miner was sued, whether in connection with his mine or not, he had a right to go into the miners' court instead of into the ordinary civil court, where, the idea was, he might not receive full justice. The court's jurisdiction extended to criminal cases, but was usually limited to civil cases. For a period, at least, in Cornwall and Devon, criminal cases were tried in the miners' court, and every suit in which a miner was directly or indirectly connected might be tried in that court.

The miner was surrounded with certain other protections and safeguards, even including freedom from taxation, the idea being to encourage him in his work. His tax was paid through royalty on the product of his mine. The free miner's right undoubt-

edly owed its origin largely to this willingness to encourage the miner in every possible way; in other words, this right which a man had to go on another man's property, discover a mine, and get the benefit of it, was foreign to almost all the law that had previously existed—foreign to the Roman law especially, which had been a leading factor of civilization up to that time.

A question has arisen, and has been widely discussed, as to the way in which these rights originated in England. There are so many points of similarity that many think that these laws came from Germany, as, undoubtedly, a great many rules did come. We shall probably never be able to determine which rules are of Germanic origin and which were peculiar to England, by reason of the antiquity of mining in both countries. In certain districts of England mining can be traced back a great deal further than in Germany. Cæsar wrote of one place in England where the lead miners were carrying on their work under peculiar rules of their own creation, and that record antedates anything we know of similar character in Germany. Yet there is undoubtedly an impress of Germanic features. The ruling monarch of England, in order to stimulate mining, would frequently call over some of the highest trained Germans in the art, and would give them charge of all the royal mines. There were also numerous importations of German miners, whose skill surpassed anything to be found in Derbyshire or Cornwall. These miners and supervisors brought over certain legal ideas, which became engrafted on the old systems and customs that had existed from time immemorial in England. Thus many points of similarity are to be found. Most remarkable is the similarity of terms; many of those which we attribute to the Cornishmen can be traced back into Germany. Many terms are identical; many have been changed by translation into another language, but these alterations offer no trouble to etymologists.

Another point in connection with mining rights is that of water rights: the right to the water required to wash the ore, to run the mills, and to generate power. Those rights were exercised in Germany, and afterwards in parts of England, in much the same way as in the early California days. The miners appropriated certain water rights and formulated laws to govern them. The miners of California are responsible for the water laws which are now enforced in the agricultural districts. The right to take timber was another privilege which these free miners asserted, both for use in their mines, and for fuel for smelting and other operations. We also find peculiar provisions regarding debris in the case of placer and tin mines, which were

so prominent in England. In fact, to read some of the old accounts of the destruction resulting from extensive washing of the tin deposits into the streams, and to study the restrictions placed upon mining in order to keep harbors and streams navigable for small boats would almost make you think you were in California, discussing hydraulic debris in the Sacramento Basin.

Another feature of Germanic origin which has been transplanted into the mining laws of all civilized countries is the manner of claiming discovery. Since the miner was given the right to go into the public domain, he had to distinguish his claim from the rest of the ground, in order to take it away from the agriculturalist; that right was derived from the Germanic law and from that of various other countries, which I shall mention now.

I used to wonder, when I studied the Spanish and Mexican mining laws, why it was that they held so many points of similarity to the old English laws. The fact is that, while the English received many of their laws from the Germans, the same law had been adopted by Spain, practically entire. We would naturally suppose that the Roman civil law would have been impressed upon Spain, France, and other Mediterranean countries. The civil law maintained that mineral belonged to the owner of the surface, and that he was the one to be consulted as to whether or not it should be worked; whereas the Germanic law separated minerals from the surface, and gave the right to work them to the free miner, who discovered them, whether he owned the surface or not. We find in Gamboa's Ordinances the statement, very broadly made, that the Spanish laws, which were adopted largely for the control of mining in Spanish America, were patterned after the German law. The King of Spain appointed a commission to examine the mining laws of the world, to decide which law was best fitted for the New World, in order to stimulate men to go there and open mines. After examining the existing mining laws, they adopted the German idea, because it rewarded the discoverer, gave him an incentive to explore, and when he had found mineral gave him the reward of his industry, reserving only a royalty. The result of this stimulation was the tremendous revenue that helped to build up the Spanish navy and made Spain at that period the greatest nation of the world. Those laws naturally came over into Mexico, and even when Mexico had gained its freedom it retained a great many features of the Spanish law, that is, of the Germanic.

In France we find that the Germanic influences have migrated across Belgium. Although France had long been under the Roman law, the German mining law was so well suited to the conditions, that it was adopted in France and overthrew the other system to a great extent. I am aware that the French writers are not willing to concede that the German law had much influence on the moulding of the French law; but the German writers point out the similarities and show a direct effect of the Germanic law upon the French. In fact, this impress was apparent in some of the discussions at the time the French laws were adopted, in 1791. Here Mirabeau took a leading part, and made some of his most brilliant speeches in discussing the nature of property rights and mineral rights. He took the stand that rights to the surface should be severed from mineral rights underneath, because of the peculiar character of these rights. His activities resulted in the adoption of the law of 1791, in which many of the Germanic features were incorporated.

In 1810, Napoleon had to revise the mining laws. For a long time, largely for political reasons, he was much prejudiced against this Germanic idea, the idea of allowing someone else to come on to your private property, discover a mineral deposit, and obtain the right to mine there. Napoleon practically bound himself to oppose this idea, because there was a provision in the Civil Code, which he had recently caused to be codified and adopted, granting to an owner of the surface all benefit of the ownership of everything under the surface. But some of the trained minds of France, being brought to bear on the question, argued with him and explained that this provision of the Code was not consistent when compared with another provision which specifically exempted mines from its operation. They employed the same argument that Mirabeau had used, stating that what was underneath had relation to the surface; that the surface might be divided into any number of tracts, while the mineral deposit continued uninterruptedly, and was actually an entirely different property.

I believe that a mistake was probably made in not grafting that feature upon the mining law of this country, that is, a severance of the mineral from the surface rights. Under the French law, an owner of the surface got just what he bought; if any mineral was discovered underneath, it belonged to someone else, and the State determined who could work it. Although a discoverer in France did not have such extensive rights as in Germany, it was recognized that he should have at least some rights. He was therefore granted a monetary reward as com-

pensation for his discovery, if he was not given the right to work the mine. The surface owner is compensated for any damage that may be done to his land; in fact, he is doubly compensated in a great many cases. If another man enters his ground for the purpose of mining, he has to put up a bond to cover double the damage that may be expected reasonably to result. Where his mining operations are extensive, he may have to buy the land if the agriculturalist so chooses, and up to the time of the purchase he has to pay rental to the owner. Hence the surface owner gets full return for any damage that may result from infringement of his surface rights.

In practice, that is about the best system that can be devised, but an important factor in its operation is that a tribunal or council of mines inspects every application. When an application is made for the right to mine a certain discovered deposit, this council takes into consideration all the circumstances: Has the one who makes the application sufficient capital? How extensive is the property? Sometimes the surface owner has the preference; if he has enough capital they sometimes allow him to mine within his own boundaries. In this way they are able to parcel out the working of mineral properties in the most economic manner. The miner virtually has the benefit of an extra-lateral right. If he wishes to work beyond his boundaries he applies for an extension of them, and almost invariably the council will give him the right to extend his boundaries if he is in the most favorable position to mine that deposit; if he can mine it most economically, he has a right to keep on. If he finds a barren part, the council exempts it, and he has to pay no more rental for that portion. Mining properties are thus administered in the most logical manner possible.

The difficulty with that system is that the right to mine is determined by the State, and you have to look to an outside tribunal to determine your rights. While the tribunal, if it works properly, is apparently most beneficial and can direct the development of mining with the greatest ultimate economy, yet, in a region like California or some parts of Nevada, remote from administrative centers, the French system would probably have been very difficult to put in force. France is a small country, and a miner would not wait long to have his boundaries marked out. If a mine were discovered in an isolated portion of Nevada, and if the council of mines, or its American counterpart, were required to determine whether the applicant should have a right to work that particular deposit, you can imagine the amount of administration and oversight that would occur; the delays, probably, would more than overbalance the benefits

of such a method. The American system was devised with the idea of leaving as much as possible to the miner, so that he would not have to keep making long expensive trips to the seat of Government, nor cause the Government officials to go to the places where he had made his discoveries, possibly remote from civilization. Under our system, the miner marked his discovery right on the ground, and himself determined thus his own right to the claim. While the European system is good in some respects, yet it is idealistic, and, like many ideal plans, it does not always work out satisfactorily.

As a further evidence of the influence that the German mining law has exercised upon the mining codes of the world, we find that in Italy and other countries directly under Roman rule, where we should expect the Roman law to be paramount, the German idea enters through France. When Napoleon conquered Italy, the French mining law was imposed upon parts of that country; when the foreign rule was withdrawn, the French mining law was still retained in many provinces of northern and northwestern Italy. In the northeastern part of Italy we find direct traces of the Germanic law entering through Austria, where the idea of free miners' rights was favorably regarded. Thus we find that in Italy the German law has entered from two opposite sides and from distinct sources.

An interesting inquiry, which I have investigated, is whether we can trace the influence of the German law and that of Derbyshire and Devon, on the constitution of our California law. I find no direct evidence, such as that when a certain miners' convention met in a certain miners' district the miners had in mind or had in hand a copy of the mining laws, we will say, of Derbyshire, or Saxony, and that they patterned our law after that. However, many of those who created our law felt the influence of these other codes in different ways: many of them were acquainted with the Mexican and Spanish laws; many of them had been in Germany; some of them were native Germans and familiar with German law; many came from Cornwall, and a few from Derbyshire. I have tried to trace out that influence, but we are now getting too remote from the time it took place. If someone had begun such a study a few years after it happened, and had reported accurately who these individuals were who framed the early laws of California, we might now know more about it. But picking up fragments here and there, we find that the German influence must have been exercised indirectly. Reading the mining reports in Nevada County, we find that the Germans were among the first to mine quartz there. Two Germans built the first mill in Nevada County for crush-

ing quartz. They were there at the time the first locations were made and before the first rules and regulations were devised.

As for placer laws, we do not pretend to trace them to any earlier system; they grew up among men who knew nothing about mining law. These were soon joined by miners from Georgia and the Middle West, where lead, copper, and zinc mining was carried on, and they undoubtedly all helped in the framing of our early placer laws. I have tried to learn about mining customs in Georgia. I find nothing on that subject except the general statement that in South Carolina and Georgia mining was carried on under possessory rights. Most of the mining was placer work. A peculiar set of mining rules flourished in the vicinity of Dubuque, Iowa; there the miners decided that they should own a certain surface area specified in their regulations. This occurred before the rush to California; hence it might have some influence on California law.

The first mining lease in Iowa was issued in 1822. The leasing law was passed in 1807, but nobody took any advantage of it because nobody wanted to be the first one to come under its provisions, since a royalty to the Government was part of the consideration. The miners resisted the proposal of the Government to lease the land, citing a provision of the Constitution, until the Supreme Court held, in two cases, that to dispose of the land covered the leasing of it. The miners then accepted the leasing system, which, however, was a failure, since it cost more to collect the royalties than the Government received from them.

I wish now to take up the subject of extra-lateral rights, a feature of our law which has caused much animosity, and a topic for debate at any time among mining men. I question whether the abolishment of extra-lateral rights is desirable, taking everything into consideration. I wish first to remove the misapprehension that it is purely an American idea, that it is found in no other system of mining law in the world; I will then explain why it has not been adopted in many countries of the world, after having been in force in some of them for centuries.

In the first place, we find that in Germany an extra-lateral right was exercised. The argument is made that if Germany abolished that feature early in the last century, America should not hesitate to do the same. It is true that if we had the German extra-lateral right, we would have abolished it long ago, because nothing could be more intricate and indeterminate. With the aid of a number of German mining dictionaries, it has been possible to arrive at a fairly intelligible guess at the shades of mean-

ing of some of these terms describing different classes of veins, but where the rights are segregated into different classes, and the shades of meaning between them are refined, it is very difficult to be sure that you are right. By translating the work of one author on the subject and dropping that, then translating the work of another author independently, and comparing these, it will be possible to gain more and more light on the subject, and some day I hope to be able to report something definite about those rights. I can only say now that mining areas were left in a very indefinite condition until they were measured and marked out. The miner was allowed a certain length of time in which to develop his mine, and when it was sufficiently developed he could apply to the mining official to complete the squaring of the vein, the *Vierung,* which squared with the end line. A similar idea came down to us, perhaps not from Germany or Derbyshire, or both, but arising from the natural logic of things. But unlike our extra-lateral rights, a German miner was entitled to a definite distance of 3½ *lachters* in the hanging and 3½ *lachters* in the foot-wall. In some districts he was entitled to take the full distance of 7 *lachters* in the hanging or in the foot-wall. This width went down to form a parallelopipedon in the earth, but, so far as can be ascertained, it did not follow the vein indefinitely. If there was a fault which threw the vein out of this squaring, they lost the right to follow it. There were a great many other regulations: If the vein was curved, the line of the strike was broken; under certain conditions, where the vein branched or where there were several veins, great complexity in the line arose; and, in fact, the law was not definite on many points. Their mining regulations contained a few general provisions as to how this extra-lateral right should be exercised, but it remained for the Court and custom to settle their disputes. In short, our system of extra-lateral rights is very simple in comparison with those of Germany. Some of the local regulations say distinctly, "If our regulations do not contain any provisions regarding a certain case, then the courts are entitled to go to the nearest district where mining is carried on extensively, or where a pertinent legal provision can be found, and the case shall be decided by that law." Thus the Germans ultimately procured a common law of extra-lateral rights, which was the result of decisions and interpretations given by the writers. This common law was gradually repealed between 1820 and 1840. The adoption of the Prussian law in 1865 finally repealed it entirely, within Prussia.

In Derbyshire, we find the purest form of extra-lateral right that exists in the world. At the same time, the law itself contains very little on the subject; it does not state how the end lines shall be marked out; it simply prescribes certain length along the vein. This measure, or "meer," is staked out by the discoverer, and certain additional claims if he has the ability to work them; the King and the Barmaster have rights to certain claims beyond the discovery claims, on both ends. The vein was taken in the same manner as in the early days in our country, with no attention to the surface. Enough surface was granted to enable an owner to wash his ore, build change houses, and place machinery necessary for working the mine. The practice was to measure a certain length, which in one district was 29 yd., or one meer, and in another district 22 yd., and this length constituted a claim. Finally, because of the necessity for determining specifically what surface might be taken on each side, they decided it should be a quarter cord. The next question was whether it should be measured from the middle of the vein or from the wall of the vein on each side; it was finally decided that it should be measured from the walls of the vein, so that a wide vein increased the width of the claim. Although the miner held a quarter cord, the farmer had the right to use as much of the surface as the miner was not using. Nothing was said about following the vein to a certain depth; in the German law the depth was without limit, but under the Derbyshire law this feature was left to inference and conjecture, although decisions on that point indicated that the owner might follow his vein indefinitely.

This matter was settled for Great Britain by a Royal Commission on mining royalties, which was appointed to examine the mining laws of the world relating to royalties. Miners were called into consultation from all the world, from America, from all parts of England, from Germany; the British foreign representatives were required to report what royalty was being paid in each foreign country. The head stewards of the high and the low peak of Derbyshire stated specifically that they had the right to follow their veins indefinitely downward and extra-laterally; although that right is not expressly granted in the statute, it is exercised.

In the United States, quartz mines were first located in 1850; the earliest regulations were passed in December, 1850, in Nevada County, Cal., granting rectangular plots 40x50 ft., and later 100 ft. square; it was entirely a local affair. Until the law of 1866, California miners acted under rules formulated by themselves, for application in each mining district. It is surpris-

ing that recent discussions on extra-lateral rights often place the so-called "iniquity" upon the lawyers; as a matter of fact, lawyers had nothing to do with it. In certain mining districts the rules excluded lawyers—a lawyer was not allowed to represent a litigant nor a miner who complained that his rights were being infringed; but if one party was a lawyer the other became entitled to hire a lawyer. That idea went to Alaska; in the last gold rush the same rule applied; lawyers could go there and mine, but no law was to be practiced there.

Extra-lateral rights were never granted by state statute. In 1850 the miners' regulations were law, so that until 1866 the miners recognized no sovereign law, that is, law imposed by state or federal government. The laws of the various districts finally came to have more or less uniformity in general features, as exemplified in that classic work by Clarence King, in Volume 14 of the Tenth Census.

In France certain extra-lateral rights existed, having grown out of the custom of granting rights to mine inclined beds; this practice was authorized by the Statutes of 1791 and 1810. In Italy we find it again; in the Neapolitan District they are permitted to mine outside their boundaries if they find the mineral deposit extending into adjoining ground.

In Mexico extra-lateral rights are recognized in two forms. First, we find in Gamboa that when a person mined outside his boundaries, if the adjoining ground was not claimed by another, he could keep on indefinitely. This matter is so interesting that I am going to read a few sentences from "Lindley on Mines," (new edition), in a part of a chapter which I prepared:

> We find a peculiar situation in the Arden Forest, in England. There there were no distinct boundaries for veins. They were coal mines, however. But they had a right to tunnel in, and they had a right to keep on until they broke into some one else's workings. The law read, "Until their mattocks met."

Under the Mexican law, the width of claim granted varied with the dip of the vein; as it flattened a greater width of surface was allowed; they were thus indirectly granting extra-lateral rights, and recognized the desirability of giving the miner the right to work a vein, as distinguished from ownership of the surface.

Australia offers an interesting example in discussing the abolishment of extra-lateral rights, that land commonly being cited as a mining country of first rank where extra-lateral rights are not recognized. In Australia, minerals were severed from ownership of the surface. Some of the early grants conveyed all the rights to everything, but now the exception of minerals is enforced.

In the United States, extra-lateral rights were adopted by the miners; no lawyer had anything to do with it. To the miners it seemed a perfectly natural arrangement; they did not care about the surface, but wanted to follow the vein downward. For that reason, in the early days there were no harmonious provisions as to the extent of surface to be taken. Under the Act of 1866, all kinds of areas were taken; but the vein itself was what the miner wanted, and he sought to sever ownership of the vein from that of the surface. He tried to accomplish the very thing that Germany and France and other countries had tried to bring about, in severing the two ownerships. It would have been the best thing for this country if it could have been carried out. We see the same principle now being applied in the reservation of oil, phosphate, and coal; you can now buy a homestead on coal and oil lands, and the states have the right to acquire and sell the surface of state school sections, while the mineral is reserved, even though it may not be discovered until afterward.

Senator Stewart was instrumental in framing the Act of 1866. Now, Senator Stewart grew up in a mining district of Nevada, whither the mining law had been carried from its place of origin in Nevada County, California, and he was not familiar with the source. Of course, the California law had become somewhat modified, but it still included the extra-lateral rights.

A few excerpts from a book by Clarence King will show how old the extra-lateral right is. You will remember that the first California quartz mine was located in June, 1850, and the earliest law defining claim area I can find was passed in December, 1850, in the Gold Mountain mining district of Nevada County. Here is the language of the law: "30x40 ft. shall constitute a full claim." The reason for that provision is that the miners were familiar with placer mining and they adopted its practices in their quartz mines without much consideration of detail. Gradually the area was enlarged until 60 ft. square constituted a claim; later, 100 ft. square. Almost at the same time, on June 6, 1851, in Nevada County, this provision was added in a simple little code of a few laws: "100 ft. on the ledge, with the dips and angles, shall constitute a claim." On June 7, away over in Amador County, in Dry Town or Sutter Creek district, they called a convention and passed a provision that the "size of claims in quartz veins shall be 240 ft. in length, without regard to width." On June 25, in a remote region in Mariposa County: "The interest of a party making a discovery in quartz shall be 500 ft. in length and the entire width of the vein, be that more or less." A little later than that, on November 15, 1851, in Butte

County: "150 ft. on the ledge for each person and as much ground as may be necessary for machinery." Then, on February 4, 1852, in El Dorado County: "150 ft. in length and the dip or inclination of said lead to any depth." Finally, on October 21, 1851, in Centerville, Nevada: "Claims shall be 50 ft. along the course of the ledge with its dips, breadths and angles."

By way of further evidence that the Cornishmen or the Derbyshire men had something to do with our mining laws, every now and then we find a Cornish term. In one of the regulations the word "fitters" is used, "dips, angles and fitters." It is an alteration of the word "flitters," which means fragments, or float, broken off from a vein. The regulation called for everything within the ground, including float. The word "slide," a Cornish term, is also used in some of the regulations. The word "spur" came from the German law.

I had intended to discuss a little more fully some of the problems that arise in connection with extra-lateral rights, and with the provisions for the performance of annual labor. The latter is one of the features of the law that can be amended with profit. It has already been done in Alaska, and the regulation made very drastic; there they have provided that a miner must record his annual labor certificate, in default of which he forfeits his claim. It is further provided that if, in filing his record, he swears to anything that is false, it is perjury, and he shall be liable to imprisonment not less than one year nor more than five. This regulation is possibly so drastic that it will be hard to get a jury to convict an offender, but some such procedure is probably the best way to solve the annual labor question. I have always felt that while a great many persons criticize the annual-labor feature of the law, the trouble is not so much the fault of the law as lack of proper enforcement. I appreciate that in many instances the performance of annual labor is only throwing money away, but at the same time we must recognize the other horn of the dilemma, that the fundamental principle of the provision is to insure development.

Prof. Christy.—It has been suggested that if all the mining districts had adopted right-angled end lines there would have been less litigation arising from the principle of extra-lateral rights. But that would have defeated the main purpose of a mine location, which is to follow, not so much the mere vein, but the ore shoot, which usually is inclined to the line of strike.

Mr. Colby.—That is very true. It is often a great advantage to incline your end lines, and that is why the law was amended in 1872. It is interesting to know that Senator Stewart intro-

duced a bill in 1871 to require all end lines to be made at right angles, supplementing the law of 1866, which, of course, had permitted a great deal of extra-lateral freedom.

Mr. H. C. Hoover.—I have been very deeply interested in this whole subject for many years, and I had always hoped that some competent lawyer would take it up; in fact, I have urged many to do so, and I was delighted a year ago when Mr. Colby took it up. However, if I really began to speak on this subject we should be here all night. I should have liked to enlarge on one phase of the subject, the question of compulsory labor on mining claims. The amount of annual work required is comparatively small in America, amounting only to 24 days in the year; this requirement has been imposed with a great deal more severity in practically every other country.

Prof. Hersam.—It is remarkable that the extra-lateral rights idea followed a line of development parallel with the feudal system in those countries which had relatively few freeholders, while the civil law developed most strongly in those countries which had more property holders, less democracy, and fewer individual rights. One wonders what became of the German law in England, and how it became the custom in Wales and Cornwall; whether it was simply an influence that came after the Norman conquest, or was introduced by the influence of those people. It would seem that there could be no place for the observance of the German law in England as a whole, but only in the outlying parts and in Wales. It would be interesting to know whether in King Alfred's Code there was any allusion to mining terms or a mining law.

Mr. Hoover.—No, there is nothing of that nature there.

Prof. Hersam.—How can we then say that the English law emanated from Germany? Might it not have had a spontaneous origin as a human custom, that is, a natural law?

Mr. Hoover.—We have this evidence: In Germany we find the first written law on the subject, and in England are these different districts, the law in each having a different origin. In Derby the law is a direct Saxon importation, beginning with the Saxon invasion of England when a portion of the Saxons remained as actual settlers. As evidence of this, we find that a number of the old Derby mines are named after the Saxon gods. Cornwall, on the other hand, was never invaded by the Saxons. The Cornish conception is a good deal different from the German, and it is my belief that the Cornish law is more or less an

inheritance from the Roman Code, that the miner's conception of his rights was distinguished from ownership of the surface in the same manner as in the Germanic idea. I have an idea that when the Romans retired from England they left a flourishing mining industry, while those districts unoccupied by the Romans continued to hold the German conception; this applies to Wales and Cornwall, and possibly to North Cumberland.

Mr. Colby.—Is it not also true that the early mining rights in Cornwall were confined to placer mines of stream tin, lode mining in Cornwall being of comparatively recent origin, that the law was designed mainly for mines of that character, and hence contained no provision for extra-lateral rights? This question occurs to me because Yale says that probably our extra-lateral rights could be referred to Cornwall and Derbyshire.

Prof. Hersam.—The feudal laws gave the miner special privileges; while other people were attached to the soil, the miner was a freedman.

Prof. Christy.—That is remarkable but also perfectly natural, because any one who has a monopoly of information on a subject can rightly dictate his own terms; those miners, who had geological knowledge, had power. As they could not be forced to discover mines, they had to be coaxed, and thus the feudal powers had to give them freedom in order to get anything out of them.

Mr. Colby.—There is no question about that, and I believe the leading German writers on the subject state that the mining institutions were most persistent for that reason, that the miners had a monopoly of the knowledge to carry on their particular industry.

Mr. Bain.—I move a vote of thanks to Mr. Colby for his most instructive paper.

The motion, duly seconded, was carried viva voce, and the meeting adjourned.

H. Foster Bain,
Acting Secretary of Section.

COMMUNICATIONS

Award of Annual Medal.

F. F. Sharpless.—I gather from the bulletins of last year, that it was the consensus of opinion that the simplest way in which to arrive at the method of selecting the recipient of the

medal, was to first select the subject and after this was decided upon, it was not difficult to select the individual.

There are many subjects intimately connected with the science of recovering metals and each of vital importance in the chain of many links.

On page 267, of the Bulletin for 1913, Mr. H. H. Knox suggests a list that might be further expanded and the field still remain uncovered. In these and other subjects, we know of men who have attained eminence, and many of us must regret that we have not more medals with which to show our respect and admiration for those who are worthy of more than we can give them.

The engineer, the geologist, the chemist, the metallurgist, the instructor have all done so much for the general advancement of the science, that it is difficult for one to decide which should first receive our consideration. When the decision is made by or for us, then there is less difficulty in nominating the candidates, but when nominated and selected have not many of us a little regret that we have overlooked a man more worthy of consideration?

While it is the specialist who has made the advances in knowledge, is it to this or that specialist to whom we are most indebted for the present position of our profession?

I believe our greatest debts are owing not to the specialists, but to the broad minds that have used the work of specialists, to the men who may not have achieved the greatest eminence in any one line, but have shown great ability in nearly all. There are a few such characters, not many, to whom we daily refer with respect and admiration, these, the master minds of our profession, our ideals seem to me fitting subjects for the bestowal of our respect, our medal.

E. G. Spilsbury.—With regard to the circular relating to the award of the Society's medal for 1914, may I suggest that while no regular action of the Society has been taken on Mr. Knox's letter of some time ago advising a change in the method of procedure, it would be perfectly competent for the Secretary to ask the membership through the bulletin to give some expression of opinion as to the "Subject" for which this year's medal should be awarded. If a given subject is decided on, it at once limits the proposals for candidates to the men especially prominent in the handling of that subject, and it is more likely to call out a full vote, resulting in a good majority to one of the candidates, than under the present method of asking for nominees in any branch of the profession.

I would suggest as a subject that the next medal be awarded

for "Prominence in the administration of successful Mining and Metallurgical enterprises." I have noticed that it is all too common a practice to award Society medals for some one spectacular invention or discovery, but to ignore the technical manager of large enterprises who is generally far too busy trying to make a success for his stockholders to devote himself to spectacular engineering feats which might tend to make his name a household word.

It is the technical administrator more than the financier who either makes or mars the enterprise, and yet how seldom is he recognized or rewarded publicly by his own professional colleagues. It is men like Thayer, Channing, Bradley, Jackling, Ricketts, Catlin and Douglas who to my mind should be rewarded by the Society for the services they have rendered to the profession, and especially to the younger and still rising members of our National societies.

OBITUARY

William Bleecker Potter died at his home in St. Louis, Mo., July 13. He was born in Schenectady, N. Y., being a son of the late Bishop Horatio Potter of New York. Bishop Henry C. P. Potter, famous in subsequent years, was his cousin. Professor Potter was graduated from Columbia College with the degree of A.B. in 1866, and from the Columbia School of Mines with the degree of E.M. in 1869. In 1869 he also received from Columbia the degree of A.M. Immediately following his graduation, he became an assistant in the Department of Geology of the Columbia School of Mines and filled that position from 1869 to 1871, being at the same time also an assistant on the Geological Survey of Ohio. In 1871 he was appointed Professor of Mining and Metallurgy in Washington University, St. Louis, Mo., and occupied that chair until 1893. During his professorship he served for two years, 1872 to 1874, as an assistant on the Geological Survey of Missouri. From 1876 to 1878 he was mining engineer of the Pilot Knob Iron Co., and metallurgist of the Vulcan Iron & Steel Works, St. Louis, Mo. From 1882 to 1893 he was mining engineer of the Iron Mountain Co., Missouri. Resigning from his professorship in 1893 he became consulting mining engineer and metallurgist and manager of the St. Louis Sampling & Testing Works, a works started in 1886, which conducted general engineering, chemical and metallurgical investigations. Professor Potter was manager of this business, which he founded, up to the time of his death.

Professor Potter received many professional honors. In 1887 he was president of the St. Louis Engineers' Club and in

1888 was president of the American Institute of Mining Engineers. He was a member of the board of managers of the Missouri Geological Survey from 1889 to 1893. In 1904 Columbia University conferred upon him the degree of Doctor of Science. He was one of the charter members of the Mining & Metallurgical Society of America. Professor Potter was married in 1888 to Agnes Kennett Farrar of St. Louis, who survives him. He leaves also two daughters and two sons.

PERSONALS

Albert Burch will be manager of the Aurora Consolidated, recently taken over by the Goldfield Consolidated, and will retain the management of the latter company.

J. V. N. Dorr was given the honorary degree of Mining Engineer at the recent commencement of Rutgers College, New Brunswick, N. J., in recognition of his contributions to gold and silver metallurgy.

Dr. Edward Dyer Peters has received the honorary degree of Doctor in Engineering from the Royal School of Mines, Freiberg, Saxony. The degree was conferred upon Prof. Peters in recognition of his distinguished academic and practical services and learned writing in the department of the metallurgy of copper.

R. S. Rainsford, who for several years has occupied the position of general manager and mine manager of the Argonaut Mining Co., at Jackson, Amador County, Calif., has resigned from that position, his resignation taking effect on July 1. He will accept a position at Detroit, Mich.

H. L. Smyth is to be the head of the combined school of mines of Harvard University and Massachusetts Institute of Technology.

Arthur L. Walker, who has been visiting metallurgical plants in Michigan and Montana, sailed on July 9 from Vancouver for a holiday visit to Japan and China.

At the fiftieth anniversary of the Columbia School of Mines, the following members of the Society were among those who received the honorary degree of Master of Science: J. Parke Channing, R. V. A. Norris, and A. S. Dwight.

MEMBER ELECTED IN JUNE, 1914

Hansell, N. V. .....50 Church St., New York
Mining Engineer.

Mining and Metallurgical Society *of* America

Vol. VII August 31, 1914. No. 8

ANNOUNCEMENTS

Change in Secretary's Address.—The office of the Secretary-Treasurer has been moved to the Hill Bldg., 10th Ave. and 36th St., New York.

Addresses Wanted.—Mail addressed to S. L. Rawlings, Mgr., San Luis Mining Co., San Dimas, Dgo., Mexico, and A. Hoffmann, Handtverkargatan 15, Stockholm, Sweden, has been returned by the post office as unclaimed. The Secretary will be glad to hear from any members who know their present whereabouts.

New York Section.—A meeting of the New York section will be held at the Engineers' Club on Tuesday, Sept. 15, at 8 p.m., preceded by the usual dinner (informal) at 6:30 p.m. As this will be the first meeting after the summer season, officers for 1914-15, consisting of chairman, vice-chairman and secretary, will be elected. The subject of the discussion has not been finally chosen, but it will probably be "The effect of rainfall on local geology and ore deposition."

Annual Medal.—In this issue of the bulletin are published three communications on the subject of award for the Society's gold medal. These are in addition to the regular blanks returned by a number of the members and are presented to give an idea of the trend of opinion. However, many members have not yet expressed their views on this subject. There is still time for communications to be considered by the council if they are sent promptly to the Secretary.

Local Sections.—The secretary of a local section has requested a statement of the position of members of a section in the matter of assessments to defray the expenses of the section. The rules provide that such assessments shall be levied as the section may determine, and delinquency for more than one year shall be a reason sufficient for the suspension or termination of the membership in the Society of a delinquent member. The section itself can not so suspend or expel and the assumption is that

the section officers would report such a delinquency to the Council, which may for this reason drop from membership, just as it may drop a member delinquent in his annual dues to the Society. The secretary of each local section is required to notify the secretary of the Society as to the names of members enrolled in his section. No measures for such an enrollment on the part of a new member are prescribed. The presumption is that a local secretary would inquire of a new member if he desired to be so enrolled, after which he would be subject to the local expenses and responsible for his share unless he withdrew from the section by serving written notice to the secretary of the section.

Thus, a member of the Society residing in New York need not be a member of the New York local section unless he wants to, and yet would have the right to attend its meetings, it being in the rules that "all members of the Society shall have the right to attend all meetings of all sections." The annual dues to the Society do not cover the cost of section meetings, although there is a small contribution from the general treasury in aid of such meetings, especially to secure adequate reports thereof for publication in the bulletin. It was the purpose of the organizers of the Society in drafting the by-laws and of the council in drafting the rules to make it optional with each member as to how much expense he desired to incur. All members pay their annual dues to the Society; those who regularly participate in the meetings of sections pay the expenses thereof; those who participate in the informal dinners preceding meetings pay for what they have.

The expenses of local sections are small. According to rules of the Society they may not exceed $5 per member per annum and the experience has been that in fact they are much less than that. These expenses consist chiefly in postage on notices, in reporting the proceedings at the meetings, and in paying the charge for the room in which meetings are held.

Election of Councilors and Officers.—On or about Oct. 1, the usual blanks requesting nominations for officers and councilors, to take the places of those whose terms expire, will be sent out. In this connection the attention of members is directed to the changes proposed by the Secretary in districts 1-2-3 and 4-5, whereby "New Jersey" is taken from districts 4-5 and included with the first group, which becomes "districts 1-2-3-4," "Ohio" and "West Virginia" are transferred from districts 4-5 to district 6; "Pennsylvania", with 24 members, becomes district 5. This means that district 5 will, of course, have only one councilor and the councilor to succeed F. Lynwood Garrison whose term expires January, 1915, will be chosen from the members of dis-

tricts 1-2-3-4, making two councilors to be elected from that group instead of one. On this account six members should be nominated from those districts instead of three.

The arrangement of the other districts remains the same as last year, the membership having increased more or less proportionately.

The following letter has gone to members of the Council:

Dear Sir:

Article 7 of the by-laws of the Society provides as follows:

"The council shall from time to time divide the territory occupied by the membership into 12 geographical districts to be designated by numbers. Each of the districts shall be, as nearly as practicable, contiguous territory; and each shall contain, as nearly as practicable, an equal number of members. The council shall announce such division to the Society three months before the annual meeting."

I have made the division for 1915 as per the enclosed sheet. Will you do me the favor to return to me at your first convenience the sheet enclosed herewith, endorsed with your approval or disapproval?

Yours very truly,

W. R. INGALLS, *Secretary.*

GEOGRAPHICAL DISTRIBUTION, M. M. S. A., AUG. 1, 1914

Membership eligible to vote 247. Divided by 12 the quotient is approximately 20.6. Upon this basis the following division is made:

Districts		
1-2-3-4	New York (62), New Jersey (4), New England (14)	80
5	Pennsylvania	24
6	District of Columbia (10), Southern States (7), Maryland (1), Ohio (2), West Virginia (3)	23
7	Michigan (7), Minnesota (4), Wisconsin (2), Illinois (1), Iowa (1), Missouri (5)	20
8	Colorado (13), Utah (7)	20
9-10	Oregon (1), Alaska (2), Northern California (36), Philippine Islands (1)	40
11	Arizona (7), Mexico (2), Texas (2), Southern California (9)	20
12	Montana (3), Idaho (3), Nevada (3), Washington (3), Canada (8)	20

COMMUNICATIONS

S. W. Mudd.—I have read with much interest the letters of Messrs. Sharpless and Spilsbury, which appeared in the July bulletin and I fully agree with the suggestion made by these gentlemen, that the medal to be next awarded should be for distinguished success in the administration of mining and metallurgical enterprises. The opinion expressed in the last paragraph of Mr. Sharpless' letter will, I think, be concurred in by many of our members.

Morril B. Spaulding.—In the July, 1914, bulletin there are printed two communications in regard to the award of the annual medal. I certainly feel that we are greatly indebted to those who have achieved success in the profession of mining and metallurgy. I heartily agree with the suggestions as brought forward by Mr. Sharpless and Mr. Spilsbury and believe there are many more members of the Society having the same views.

George E. Collins.—I have looked over the annual medal award circular and send herewith my suggestion for a subject. This time I found it easier to suggest the subject than the most suitable recipient. I should like such an honor to go to the person who has done most to uphold the standard of the profession, quite regardless of the degree of material success that has attended his work.

In my judgment, the best justification for such honors is that they enable us to reward, or at least to identify ourselves with and commemorate, achievements which do *not* command an adequate market price. Last year I suggested Hoover's work as a suitable subject, largely because it was a labor of love, which from the nature of the case could not be remunerative.

I should therefore emphatically dissent from Mr. Spilsbury's suggestion (in bulletin for July 31) that the next award be for "Prominence in the administration of successful mining and metallurgical enterprises." Success in this direction is usually arrived at mainly with a view to the pecuniary reward; and this, fortunately, usually follows its attainment. I want to see the Society award its medal for work which otherwise might go unrewarded.

PERSONALS

R. W. Brock has resigned his position as Director of the Canadian Geological Survey and Deputy Minister of Mines, to become professor of applied science at the new University of British Columbia.

Frederick G. Cottrell has been appointed chief chemist of the U. S. Bureau of Mines.

D. M. Riordan sailed on the U. S. cruiser "Tennessee" as the special agent of the Secretary of the Treasury in the distribution of aid to the Americans stranded in Europe. Mr. Riordan rendered great help at the time of the San Francisco earthquake, so that he is peculiarly suited to be of service in the present emergency.

A. L. Queneau has been at Jemeppe, on the Meuse in Belgium, during the last year, engaged in some experimental work in zinc smelting. The Secretary of the Society received a personal letter from him, dated Aug. 3, which will be of interest to all his friends. After telling about his experimental work and rejoicing over some promising results lately obtained, he continues: "But, alas! I have now to start to rejoin my old regiment, Germany having declared war on France, and everyone and everything must be abandoned. I leave Mrs. Queneau with the children here, as it is probable that Belgium will maintain her territory free from the invasion of Germany. Belgium has now some 250,000 men in the field, a force sufficient to make Germany think twice before violating her neutrality. M. de Sincay has promised to look after my family during the war." M. de Sincay is the director-general of the Vieille Montagne company. How little did Mr. Queneau foresee what was shortly going to happen in Belgium!

MEMBERS ELECTED IN AUGUST, 1914

Foote, Arthur B. .....Grass Valley, Calif.
Supt., North Star Mines Co.

Garrey, George H. .....115 Broadway, New York
Consulting Mining Geologist.

McMeekin, Charles W. .....Nevada City, Calif.
Mining Engineer.

Milliken, George Fanshawe .....1 E. 39th St., New York
Consulting Mining Engineer.

Van Arsdale, G. D. .....Douglas, Ariz.
Research Chemist, Phelps, Dodge & Co.

Whitley, Charles Walter .....Salt Lake City, Utah
Gen. Mgr., Utah Dept., American Smelting & Refining Co.

CHANGE IN ADDRESS

Drake, Francis,
Care of Mining and Metallurgical Club, London
Wall Bldgs., London, Eng.

Mining and Metallurgical Society *of* America

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ANNOUNCEMENTS.

New York Section.—A meeting of the New York section will be held at the Engineers' Club on Thursday, Oct. 15, at 8 p.m., preceded by the usual dinner (informal) at 6:30 p.m.

Badges.—Arrangements have been made whereby the badges of the Society, either in the form of pins or watch charms, may be still obtained at the price of $5.

W. R. INGALLS,
Secretary.

MEETINGS OF SECTIONS

NEW YORK.

The first meeting of the New York section for the year 1914-1915 was held at the Engineers' Club, on Tuesday, Sept. 15, 1914, at 8 p.m., Mr. E. Gybbon Spilsbury presiding. The following members and guests were present:

R. C. Canby, L. V. Emanuel, J. R. Finlay, N. V. Hansell, H. W. Hardinge, Theo. J. Hoover, L. D. Huntoon, W. R. Ingalls, S. J. Jennings, J. E. Johnson, Jr., Thos. H. Leggett, W. W. Mein, Charles Mindeleff, T. T. Read, A. P. Rogers, A. H. Rogers, E. M. Rogers, F. F. Sharpless, G. C. Stone, H. F. Wierum and G. D. Van Arsdale. In the absence of the secretary of the section, Mr. Huntoon was requested to act as secretary for the evening.

The Chairman.—Gentlemen, this is the annual meeting of the section as well as the initial meeting for the year 1914-1915, and it is gratifying to find so many present, because, as a rule, the first meeting has generally been poorly attended.

It may interest you to learn that a number of our members are actively engaged in the European war, or in correcting the evils that the war has brought about. Mr. Hoover has been active in taking care of Americans in Europe; D. M. Riordan

went over as special representative of the Treasury Department, and is engaged in distributing money sent to help Americans get back to their own country; A. L. J. Queneau is fighting in the ranks; he was called to the army, and left his family to go to the war. Our sister society, the Institution of Mining and Metallurgy, of Great Britain, has even formed a special company and sent it to the front.

Proceeding to the election of officers, Mr. Sidney J. Jennings was nominated for chairman; there being no further nominations, Mr. Jennings was declared unanimously elected to the office of chairman for the coming year. On nomination, duly seconded, and no other nominations being made, Mr. A. H. Rogers was declared unanimously elected vice-chairman for the ensuing year. The chairman suggested that the present secretary-treasurer be re-elected. Nomination being seconded, Mr. D. M. Liddell was declared unanimously elected.

The chairman announced that because of the absence of the treasurer, on account of illness, the reading of the treasurer's report for the past year would be postponed until the next meeting.

The chairman then stated the subject for the evening's discussion would be the Hall process, of which Mr. H. F. Wierum would give a description, including the difficulties in its introduction, its successes, and also investigations in Europe and the United States as to the best conditions under which it can be installed.

The Hall Process of Desulphurization.

H. F. Wierum.—It is an unusual privilege for me to have this opportunity of addressing a body of technical men on a technical matter which not only interests me more deeply than any other technical problem I have ever encountered, but also, I fully believe, interests the smelting world in a large degree. I will endeavor, therefore, to give you a succinct and straightforward account of what has been done, as well as what has not been attained in the development of this process, and if it is according to the custom of the meetings of this Society, I shall appreciate the opportunity of answering with perfect freedom any questions addressed to me. It will be my endeavor to keep real facts distinctly separated from mere opinions.

The Hall process aims to eliminate sulphur from sulphide ores or mattes, without allowing any SO_2 to escape, and to recover the sulphur thus eliminated. For some four or five years prior to 1914, my task had been to make as much gas and as rich in SO_2 as possible, to make sulphuric acid at the Tennessee

works, of which I had charge. It was quite a wrench to my feelings, therefore, to face about and try to make a gas containing as little SO_2 as possible. But my interest in the process soon became fascinating, and it was a tremendous disappointment for me to have to stop the work in California just as the fundamentals were being well developed.

William A. Hall, the inventor of this process, tested his first ideas, I believe, at a little place near Paris, called Levallois. He used a small brick-lined circular furnace, 18 in. or so in diameter, with a removable tile top, into which he introduced pyrites and which he heated by a very low-grade producer gas carrying but 130 B.t.u. per cubic foot. The results obtained in this furnace were important only as an impetus to further investigations. No matter how many pounds of pyrites were treated, or how many cubic feet of gas were used, the tests resulted in a fairly complete desulphurization of the pyrites without yielding any detectable sulphur dioxide; the fumes from the discharge pipe of this furnace apparently consisted of white or yellowish-white sulphur vapor. Steam in small but unmeasured quantities was introduced with the gas through jets placed between the gas burners on the furnace. It was startling, to say the least, to see pyrites introduced into a glowing red-hot furnace and then to hold your face in the discharge fumes and be able to breathe without detecting any of the familiar choking odor of sulphur dioxide.

These experiments were repeated in a similar furnace, in London, and later in Brooklyn, the gas in both cases being a city product of from 500 to 600 B.t.u. per cubic foot. The results were the same. It should be noted that in these preliminary experiments air was carefully excluded from the furnace, except such air as was blown into the burners themselves, in quantities just insufficient to burn completely the amount of gas introduced. Air was excluded in an efficient manner by maintaining a rather heavy back pressure in the furnace, so that whenever an opening was made the flame and sulphur fume would shoot out instead of allowing air to be drawn in.

Of course, it has long been known that about one-half of the sulphur in FeS_2 can be distilled from it by a mere application of heat, about 1300° F. being required to start the distillation effectively. The remaining one-half, however, it has always been contended, cannot be dissociated from its combination with iron, or any other base, by simple heat. With these experiments before him, Mr. Hall drew up his first patent papers and attempted his first theory in the premises; and of the many prominent and experienced engineers who witnessed these first

little tests, I do not know one who was not strongly impressed by what he saw. They were puzzled, however, and many a pencil was set busy trying to figure out possible chemical reactions that had apparently heretofore escaped the scientific world.

Now it is possible to write a reaction which will account for what the eye saw during those short tests, but whether such a reaction actually takes place *I am not prepared to say,* and I trust you will all feel perfectly free to form your own opinions as to the feasibility of such combinations as the following. Let us assume first that about one atom of sulphur has been distilled by heat alone from FeS_2, leaving a sub-sulphide of iron, which can be roughly designated as FeS. Now comes the first chemical reaction, whereby six molecules of FeS added to six molecules of H_2O at a suitable temperature are supposed to yield six molecules of FeO and six of H_2S. Doubts probably arise at once in your minds as to the ability of any heat obtainable in a roasting furnace to decompose water in this manner. Nevertheless, here was this little furnace—with an air supply insufficient even to burn completely the gaseous fuel used—turning FeS_2 into Fe_3O_4, and having only the oxygen of *water* available as a stable equivalent for the sulphur in combination with iron. Red-hot iron decomposes water; why not red-hot FeS, or Fe_6S_7, or carbon, or red-hot *anything* that we do not know positively will *not* do it? Such were the questions we had to ask ourselves. So we go bravely on, and accuse the little furnace of decomposing enough water to satisfy the second reaction of the cycle: $6FeO + 3O = 3Fe_2O_3$. Following this comes the third chemical process, which I think is quite feasible under suitable conditions, provided the two foregoing reactions can be brought about: $3Fe_2O_3 + 6H_2S$ (if formed) $+ 5O = 2Fe_3O_4 + 6H_2O + 6S$ (free).

It seems fruitless, however, to discuss whether or not any such cycle of reactions actually occurs. I simply wish at this point to leave in your minds one fact, that in the little furnace described above, FeS_2, carrying some 48% of sulphur, *was* freed from its sulphur, down to about 5%, by a treatment with producer gas at a temperature of about 800° C., introduced with insufficient air to burn this producer gas completely, and with some steam present, while maintaining such a strong back pressure that no suction whatever existed in the furnace, and no outside air could possibly have been drawn in.

The next step was the construction of a slightly larger furnace, mechanically rabbled, but of the same general design as the little pots just described. The only information gained by this increase in size and efficiency was to obtain a record as to how long the ore was under treatment, and very accurate and

continuous data as to the amount of SO_2 in the fumes. The result of official tests conducted by two of our most respected and experienced chemists and metallurgists indicated that SO_2 was always below 0.1%; that sulphur in the calcines was 3% or under, and that the weight of ore treated per square foot of hearth area per 24 hr. was approximately the same as in the regular MacDougal furnace.

Another point was tested in this second furnace. Some chemically pure sulphide of iron was bought, answering the formula of FeS. This contained no feeble atom of sulphur, nor unstable atom, or whatever you wish to call it, and yet this material was decomposed under exactly the same conditions as the pyrites, with practically identical results. In our later trials, this experience with monosulphide of iron, and also with some matte—which roughly answers the formula of monosulphide of iron—has always puzzled me and still does so.

When the tests had reached this point, I was called upon to carry out certain experiments that had been arranged by the gentlemen controlling the rights to this process, at a large smelter in California which had been closed down for some time. As you see, I had rather meagre data for the equipment of a unit to handle 25 or 30 tons of ore a day when the largest scale upon which the process had been tried so far had been about 25 or 30 *pounds* a day. I was unfortunately much pressed for time, under existing conditions, and had to attempt the impossible in getting a gas plant built, a furnace equipped, and tests completed within three months. It was found necessary to extend the time to be devoted to the tests; when this was arranged, the gas plant was put in excellent shape, with washers and a fairly large gas holder, so that when we started up again, about the first of the year, we had good clean gas to use. During this second construction period we equipped a second MacDougal furnace with oil burners. Strangely enough, the totally unsatisfactory tests which we had made with oil burners in Brooklyn led us to believe that raw oil was not a suitable fuel for our purpose, and therefore the equipment of a furnace with oil burners was undertaken simply as a side show, so to speak. This furnace later proved more valuable to us and to our knowledge of the process than did the gas-fired furnace.

About the first of January we started up the gas-fired furnace, but unfortunately were unable to keep it operating for 24 hr. at a stretch during the whole month—not because of any difficulty with the plant or process, but simply because Shasta county, Cal., treated us to such weather as I have never experienced before. Storm after storm interrupted the power com-

munication of the plant, and we would no sooner get the furnace heated and filled with ore, and the sulphur coming off nicely through the flues, than the power would go off, the blowers and motors all stop, and immense volumes of SO_2 begin to pour from the stack. These interruptions occurred on an average of twice a day for the first two weeks of January, and nearly once a day for the last two weeks. Meantime, however, our oil-fired furnace was made ready, and we seized one occasion when the shut-down was more prolonged than usual, to put it into operation, having hastily provided steam power for most of our requirements. The early part of February, therefore, we started to run the oil-fired furnace. Although still subjected to many interruptions, we gradually eliminated these, and as the weather became kinder to us, after a week or so we began to feel that we knew what to do.

The ore which we had to treat was crushed to ½ in., and as it was not in the slightest degree friable, and was very dense, ½-in. pieces were distinctly found to be too big. Therefore, a system of screen analysis was adopted on the calcines, and while our sulphur elimination from the material which passed the 10-mesh screen seemed to improve from day to day, nevertheless we found it extremely difficult to roast the ore down to the 5% point which we aimed at under the conditions which we first imposed upon the furnace.

Careful analyses were made of the atmosphere existing on every hearth of this 18-ft. MacDougal furnace, and in the flue leading from it. For the first two weeks we devoted ourselves to tests in an atmosphere containing 1% or less of free oxygen and rather generous percentage of CO; in other words, a highly reducing atmosphere throughout. Under these conditions we failed to get a better calcination than to about 11 or 12% sulphur in the 10-mesh material. The larger pieces of ore, as they came from the furnace, were barely singed, and contained about 26% sulphur, the original ore having averaged roughly 40%. In all this period, hardly a trace of SO_2 existed in our escaping gases.

Time was again pressing and I found it impossible to try all the variations which I would have liked to try under these completely reducing conditions in the furnace. I therefore began slowly to allow a little oxidation to occur on the lower two hearths of the furnace, and while so doing we finally hit upon a set of conditions which seemed economically very important to the industry, and to the problem of fume destruction. Let me state briefly what our best results were, maintained constantly for several days, and you will be able to judge whether or not

we have reason to hope for important commercial developments in this process.

For about a week we fed at the rate of 24 tons in 24 hours. During this period the sulphur remaining in the 10-mesh calcines averaged 5½%. The sulphur remaining in the total sample, of ½-in. material, coarse and fine together, averaged about 8.8%. Oil consumption was 22 gal. per ton of ore, the oil being a very cheap material carrying 25% of asphalt and of about 23° Bé. gravity. The SO_2 in the fumes escaping from the furnace for the entire period was a trifle over 0.3%. Labor required is practically the same as for ordinary MacDougal roasting, and, of course, the more furnaces and the larger tonnage treated, the lower the labor cost per ton, inasmuch as it takes just as many men to tend and feed one furnace as four. Please note that although the figures just given you are the averages of hundreds of samples of gas and calcines, the entire period showed improvement toward the end, and gave us an opportunity to study what changes in the furnace itself would conduce to still more favorable results. Our best results, maintained for 24 or 48 hr., towards the end of this period, will probably interest you, and may be stated briefly thus: Oil consumption 16 to 17 gal. per ton of ore; 10-mesh calcines, 5.3% sulphur (although for two or three days the calcines ran between 2.8 and 3.6% sulphur); SO_2 frequently as low as 0.06%, so low, in fact, that we got tired of titrating to an end point in a very weak iodine solution.

I trust you will all bear in mind that these tests were made in an existing furnace in which all mechanical arrangements, such as speed, angle of rabble blades, depth of the bed of ore, and length of time in the furnace, had all been fixed for conventional pyrites roasting operation, whence it is not surprising that some of these conditions demanded amendment to give the best results for quite a different operation. Such amendments, I am sorry to say, were beyond our possibilities in the short time at our disposal, and our metallurgical common sense must therefore come to our help in predetermining roughly what effect certain changes will have. I think that with 10-mesh ore, and with arrangements for more frequent rabbling, and for keeping the ore in certain portions of the furnace a greater length of time than the present conventional practice provides, we can maintain without difficulty the following results. In an 18-ft. MacDougal furnace I believe we can treat 40 tons of 10-mesh ore daily with 500 gal. of oil, roasting it down to 5% of sulphur, and controlling the SO_2 fumes so that they shall never exceed 0.3%, and probably average 0.15% or less. You understand that these

figures have not been attained, but that I am giving them simply as my opinion as to what can be attained in time.

Now for a word or two about the chemical reactions. In the upper portion of the furnace about one-half of the sulphur is distilled by heat alone. The very lowest portion of the furnace, say one-third of the hearth area, is devoted to the oxidation of iron, copper, and remaining sulphur, by a free admission of air. In the middle third of the furnace a strongly reducing atmosphere and rather high temperature, say 1500° F., are maintained, and it is in this central portion of the furnace that the SO_2 formed below is broken up and reduced to elemental sulphur. It is an undeniable fact that some H_2S is formed in the upper regions, and it is equally undeniable that H_2S will react upon SO_2 under certain conditions, forming water and sulphur, but I have not been able to prove that the H_2S—SO_2 reaction is the controlling feature in the reduction of SO_2. When a too heavily reducing atmosphere is permitted in the presence of liberated elemental sulphur and steam, certain undetermined organic sulphides are formed which seriously interfere with the production of sulphur. There seem to be two ways of preventing this interference: first, avoiding too great an excess of fuel; second, a quick drop in the temperature at the point where these excess oil vapors and free sulphur exist. Naturally, the former is the more economical way, but both have proved feasible.

It is becoming evident that I cannot cover this subject so thoroughly as I would like to do, and I will therefore be very brief in stating our experience in attempting to save the sulphur. We provided a Feld washing machine to clean the elemental sulphur from the gases, and for the first two or three hours after a free discharge of sulphur had been secured from the furnace, it looked as though this machine would take care of the sulphur most effectively; but, if my memory serves, four or five hours' continuous running got us into serious trouble. The thick, creamy emulsion that came from the washer was led into tanks which had sand filter bottoms, the filtrate from which was beautifully clear and free from sulphur. Presently a disturbance appeared in the draft of the furnace, and investigation proved it to be caused by a complete clogging of all the gas passages in the washer. Fortunately we had provided facilities for by-passing the gases around the washer, and allowing them to escape from the stack into the air. This we did, and upon opening the washer found it completely clogged with yellow and gray sulphur, so sticky and plastic that neither a stream of water under high pressure nor a jet of steam would remove it from the interior surfaces. Those who are familiar with the construction of a

Feld washer will appreciate how impossible it was to clean the inaccessible spaces between the lead cones when once stuck up with this plastic mixture. After this first experience we were able to use the washer for only an hour or so at a time, and then very ineffectively. Most of the time our gases, which consisted of a thick, heavy, yellow cloud of sulphur, were discharged through a fan to the stack and thence out into the atmosphere. Innocuous, it is true, but tantalizingly uneconomical.

To the small furnace in Brooklyn we had previously attached a treater of the Cottrell precipitation type, and found that this electrolytic discharge was completely efficient in knocking down the sulphur. Unfortunately, business arrangements could not be made in the time at our disposal to install a Cottrell precipitation plant in connection with our MacDougal trials in California, so that until very recently I have been unable to say positively how well the liberated sulphur can be recovered. Our experience indicates that the current completely eliminates all solid sulphur from the gases, and I and most of my associates are reasonably sure that this method will prove both economical and efficient; it goes without saying that much experimentation will be required before satisfactory plant details can be worked out.

While looking into certain matters in Hungary about two months ago, I happened upon a Government sulphur factory which had been in operation for many years at a little place in Transylvania called Zalatna. I was interested to see with what facility the elemental sulphur was washed out of the gases in simple and inexpensive wooden towers containing many baffle boards over which a saturated solution of chloride of lime was flowing. The consumption of chloride of lime was almost nil; the emulsion coming from the foot of the towers was led into a series of tanks where the sulphur settled out quite completely without any filtering, and the clarified chloride of lime solution was again pumped to the top of the towers. Naturally this suggestion seems a cheap way of solving our problem; I had three towers all half built in London, with the object of duplicating the performance which I witnessed in Hungary, when the war broke out and all business was stopped. Arrangements had about been perfected whereby I was to erect a plant in the northern part of Norway, similar to the one with which I experimented in California, but the war has also put a complete stop to that, so that our Hall process has had ill luck thus far.

I have now told you quite frankly practically everything that there is to be told concerning our efforts thus far. I have found a feeling to prevail among many persons who have heard

of this process, that claims have been made which are too broad and complete to deserve credence, and I am glad of this opportunity to state that we are making no further claims than can be deduced from the talk which I have given you this evening. We realize that there are many, many points still to be perfected, but I feel strongly that we have in progress of development an important improvement in methods of handling gases which will ultimately have great weight in abating the fume nuisance and in supplying the market with sulphur. I now hope that anyone present who is desirous of discussing any particular feature of this process will feel perfectly free to do so.

A. H. Rogers.—I would like to ask how the oil jets were disposed in this furnace.

Mr. Wierum.—The upper portion of the furnace is under a nearly continuous back pressure, that is, the upper two hearths. The third hearth has no pressure. The fourth, fifth, and sixth hearths have a slight suction, increasing, of course, at the bottom. This suction amounts to about 4 mm. of water. On the hearths where there is a suction we can use any of the ordinary types of oil burners, and rely upon an aspirating effect to draw in enough air to burn the oil; but on the upper hearths, where there is a back pressure, you cannot burn oil in any of the conventional burners. I got my idea of a burner for that condition from Mr. Peabody, who has invented a burner which is used in the United States navy. This burner relies upon the pressure of the oil to atomize it; the oil at 40 to 60 lb. pressure is led through a very tortuous passage, and is finally discharged through a very small hole. This little jet is in the middle of a 4-in. pipe, through which comes the supply of air for combustion, being delivered from a fan at a pressure of about 4 in., a very small pressure. The burner is very cleverly arranged so that the direction of the air is inward and the direction of the sprayed oil is outward, so that the two counteract one another and produce a distinctly local ignition of the oil. So far as I know, this is the only burner that will maintain any desired temperature against a back pressure, and in an atmosphere containing no oxygen.

J. E. Johnson, Jr.—A few days ago I had an opportunity to see the Cottrell process in operation at the Raritan Copper works at Perth Amboy, N. J. They have it working on a fume which comes from the reverberatory furnace in which they melt down the gold and silver slime from their electrolytic refinery. This fume is extremely fine. I should say finer than that of an old-fashioned blast furnace before the day of Mesabi ores. It looks

just like the heavy smoke from a freshly started fire of wet wood. The gases are scrubbed with water before they reach the treater and all the heavier particles are taken out, so that while the fume is a dense white smoke, there is only about $^1/_{10}$ as much of it by weight per cubic foot as there is in blast-furnace gas after leaving the dust catcher. The situation is complicated by the fact that the dust is moist and that the gases contain acids of various kinds. They have had the plant in operation about 18 months and are now more than doubling its capacity. They showed me everything very clearly. I saw the smoke going in and that coming out, and I also saw the interior of the apparatus, so that with their description, I could understand it well.

The smoke coming out cannot be seen at all, either in the treater or at the top of the stack into which it discharges. I had them throw the current on and off several times in my presence and actually saw the results produced thereby. There is no doubt that the thing is genuine and that it knocks down practically all the dust. I do not believe there is any more in the gas leaving the treater than there is in an ordinary office. Not as much as in some blast furnace offices I have seen.

The moving parts consist wholly of a little motor generator set and a rectifier to transform the alternating current into direct current. This is in the power house some distance away and appears to run almost without attention. It did require some at one time owing to conditions into which it is not necessary to go, but they schemed out a method by which this difficulty is taken care of and the thing simply stands there and runs, and if you have alternating current on the city mains on 24-hour supply near you, you would not even need the motor-generator set,—only a transformer and rectifier. The conditions for blast furnaces are very much easier to meet than the conditions which they have there for two reasons,—the entire absence of acid or other corroding substance, and the fact that the gas is not saturated with moisture at the temperature at which it is treated, so that the dust has not a chance to build up on the apparatus and perhaps break down the insulation.

Mr. Wierum.—The Cottrell system is being used largely all through the West; in some places it is very successful and in others it is not a failure by any means, but the details have not yet been worked out. I would anticipate a really troublesome time in adapting the Cottrell process to this problem, though confident of final success. I know the tendency of sulphur, emulsified in water, to stick; in fact, the only surface to which it will not stick is glass; we might have glazed pipes, almost as

smooth as glass, and they could be grounded; that is a scheme I talked over with Dr. Cottrell.

Mr. Jennings.—Mr. Wierum, what would you say is the net results of your experiments?

Mr. Wierum.—The net result is that we have every reason to believe that it should be worth anybody's while to go ahead and finish these tests, at any reasonable cost, if he is interested in destroying sulphur fumes.

I have always contended that it is a mistake to apply this process to any undertaking which requires close reckoning to figure out a profit. But at such operations as those in the Ural Mountains, or in Norway, or at Coram, at all of which places they have fairly cheap fuel and sulphur going to waste, with complaints about SO_2, there is no question in my mind that the salvage in sulphur would give you your roasting absolutely free, and eliminate the nuisance. But until we know that a profit can be made, and exactly how all details finally work out, I would not like to recommend anybody's installing it, for instance, in treating low-grade pyrites where the sulphur must be paid for in the first place.

The cost of unpurified sulphur, with oil at 2.7 cents per gal., figured out roughly at $4.75 per short ton; to that must be added about $3.50 for refining, because I do not believe that this sulphur is pure enough to sell to acid works.

Mr. Spilsbury.—What percentage of sulphur was in what you call the "impure sulphur?"

Mr. Wierum.—What we got at first averaged about 89% sulphur, and then we recovered some more under rather poor conditions which contained only about 78%. Later we obtained product just as yellow and beautiful as any sulphur that you ever saw, but, unfortunately, we did not have that analyzed. The main impurities were flue-dust and lamp-black, both of which we proved could be greatly reduced through experience in mere manipulation.

Mr. Johnson.—I have heard that hydrocarbon compounds had a great deal to do with the failure to proceed with the process.

Mr. Wierum.—I do not think there is any basis for that statement. The stench was nauseating before we learned its exact origin, but it did not take us many days to learn how to adjust that; it was simply a case of over-reduction, and was absolutely corrected after a few days' experience.

Mr. Jennings.—What was the percentage of SO_2 that you thought you could attain in the flue-gas?

Mr. Wierum.—An average of 0.15%. I believe it is not quite fair to hold us to results that were obtained under stress and in such a short time as we had. Months are required to become thoroughly familiar with your apparatus, and its adjustments, and to get your crew trained. Under the conditions, Mr. R. R. Moore, whom you all know, and whom I had the pleasure of having associated with me in the experiments, and Mr. Thompson, who was kindly loaned to me from Mr. Jennings' smelter near by, and I myself, all congratulated ourselves on the good progress we were making when the test was called off. The immediate cause of our shutting down, and the failure of negotiations to proceed, was a discouraging fire which burned down the only crushing facilities the smelter had. It left us with only 200 tons of crushed ore on the ground.

After we had finished our run with the oil furnace, we started another run with the gas furnace, and had very good success; but economy of the process was out of the question, because in converting oil into gas the first thing you do is to throw away 55% of your heat, and then, for some curious reason, the actual consumption of heat units in the furnace when using gas is about one-third greater than when using oil. If we can use producer gas I do not think there will be such great waste of heat. I do not know positively whether producer gas is adaptable for the purpose, but I think so.

Mr. Jennings.—What is the status of the process?

Mr. Wierum.—Mr. Hall has sold his rights to people, mainly English, who are open to business at any time, and we are merely awaiting the end of the war to continue our important Norway development.

Mr. Spilsbury.—What do you estimate would be the actual cost per ton of sulphur—would it be possible to use this process as a method of manufacturing sulphur alone instead of sulphuric acid?

Mr. Wierum.—It would, under a certain set of favorable conditions, but those conditions are not easy to find. For instance, if we had to buy pyrites and pay anything like the market price of 10, 11, or 12c. per unit, we could not think of it. Adding the manufacturing cost to that would approach the market price of sulphur. But under conditions such as I was trying to find in Hungary, if we had had a railroad to a certain place

near a large natural-gas field, and could thus get the pyrites and gas together, and could get our pyrites for what it is being sold over there, about 8½c. a unit, I figured we could make refined sulphur for about $12 to $14 a ton, and could get a contract from the Hungarian Government for three years at 155 kronen, (about $31) per ton. Railroad freight added something like $9 per ton to the cost of delivering the sulphur. Please bear in mind that, though the market for refined sulphur is limited in comparison with the market for crude, yet it is a very large market, somewhat over 12,000 tons a year in California alone, and over 80,000 tons yearly in France, for instance, and that the sales price of refined sulphur is everywhere more than enough greater than the sales price of crude to cover the refining cost. I am not a good promoter, my friends, and hope you will all try to recall experiences in your own efforts at working out new things, so that you will appreciate my reticence in predictions. But we must also remember the huge strides which experience, concentrated on one particular practice, enables us to make year by year. Candidly I would not dare to say how cheaply I think, to myself that a ton of ore can be handled by this controlled atmosphere method. I do not forget how the cost of lead smelting came down from $2.80 to $1.80 a ton of blast furnace charge; nor how basic converting of copper promised for the first couple of years a cost of about $8.00, but has recently realized a cost of under $5.00 per ton of blister. Reverberatory copper smelting was cheap at $2.50 not long ago; now it is dear at $1.75. Just so, I look for the time through the instrumentality of the Hall process, when, to say the least, by-product sulphur will wipe out the cost of second roasting at many smelters; just as by-product acid has infused new life into Ducktown, Tenn., and as by-product power, from waste heat, has made reverberatory work a competitor of blast-furnace work. But not next week, and not without some nerve, and considerable money.

Mr. Jennings.—I have had the pleasure of being present at several sessions during the past winter under the chairmanship of Mr. Spilsbury, and have enjoyed excellent meetings and heard excellent discussions. I think it is largely due to Mr. Spilsbury's energy and wide knowledge of men that we owe this. I therefore move that a vote of thanks be accorded to Mr. Spilsbury for the delightful manner in which he has presided over our sessions during the past year.

(The motion was seconded by a number of members and unanimously carried.)

Mr. Spilsbury.—I appreciate fully your vote of thanks and assure you it has been a great pleasure, indeed, to act as chair-

man of the New York section. I think that the increase in membership of the section has been largely due to the interest that has been evolved at these dinners and discussions, but more especially to the efforts of the Society's secretary, Mr. Ingalls, to whom I think we all owe a debt of gratitude for the activity he has evinced throughout, in helping to increase the membership of the Society.

On motion, the meeting adjourned at 10 p.m.

L. D. HUNTOON,
Secretary pro tem.

SAN FRANCISCO.

The San Francisco section met in joint session with the local section of the American Institute of Mining Engineers, at the Engineers' Club, San Francisco, on Monday, Sept. 14, 1914.

Following dinner, and a paper by Mr. W. E. Colby, on the "Recent Litigation between the Argonaut and the Kennedy Extension Mines," which paper was discussed by A. C. Lawson and others, the section was formally called to order by the chairman, S. B. Christy. H. F. Bain was appointed secretary *pro tem.* Attention being called to the fact that the section now had no secretary, Mr. P. R. Bradley having resigned when he went to Alaska in May, Mr. W. H. Shockley, was formally elected to this position. The section then adjourned.

H. FOSTER BAIN,
Secretary pro tem.

OBITUARY.

August Ossian Hoffmann, a member of the Society died about a year ago, but news of his decease has but recently reached the Secretary. Mr. Hoffmann was born at Stockholm, Sweden, in 1878. In 1899 he was graduated from the Royal Technical Institute of Stockholm. In 1899 and 1900 he was engaged in work at mines and metallurgical plants in Sweden, Norway, Germany, and Austria. From 1900 to 1905 he was employed upon the Syssert estate in the prospecting for gold, copper, iron, and coal deposits; assaying, gold milling, cyaniding, and iron smelting. From 1905 to the end of 1912 he continued with the same estate, acting as manager of the Polevskay Mines and Reduction Works, engaged in copper smelting and leaching. Mr. Hoffmann was but little known in this country, but he had a circle of acquaintances among the American and British engineers who have become engaged in work in Russia and Siberia.

PERSONALS

Philip R. Bradley has been made general superintendent of the Treadwell group of mines in place of R. A. Kinzie, resigned.

Thomas H. Leggett, who has been in charge of the mining interests of the American Smelting & Refining Co., has severed his connection with that company and has resumed practice as consulting engineer, with offices in the Singer Building, New York.

R. A. Kinzie and E. P. Kennedy, respectively superintendent and assistant superintendent of the Alaska Treadwell group of mines have resigned. Mr. Kinzie will go to California with his family, and Mr. Kennedy will open offices in Juneau in connection with the Speel River electric power project.

Prof. H. S. Munroe is now at his summer place in Litchfield, Conn. He has not fully recovered his health and does not expect to return to New York until the middle of November.

C. W. Hayes who has been Vice-President and General Manager of the Mexican Eagle Oil Co., with headquarters at Tampico, has left Mexico for England. He retains his connection with the Eagle Co. as First Vice-President, but will no longer act as General Manager. He will be occupied chiefly as geological adviser to S. Pearson & Son, Ltd., and his permanent address will be 47 Parliament St., Westminster, London, England.

CHANGES IN ADDRESS

Bradley, P. R. .....Treadwell, Alaska

Hixon, H. W. .....care of The Covington, Philadelphia, Pa.

Leggett, Thomas H.....149 Broadway, New York

Linton, Robert.....525 Penn Ave., Pittsburgh, Pa.

Van Arsdale, G. D.,
care of Phelps, Dodge & Co., 99 John St., New York

Williams, R. B.....96 High St., Newburyport, Mass.

Rawlings, S. L.....West Coast Life Bldg., San Francisco, Cal.

Staunton, W. F.....512 So. Harvard Blvd., Los Angeles, Cal.

White, R. T..care of F. A. Mattievich & Co., Batoum, So. Russia

Mining and Metallurgical Society *of* America

Vol. VII October 31, 1914. No. 10

ANNOUNCEMENTS.

New York Section.—A meeting of the New York section will be held at Browne's Chop House, Broadway, near 40th St., on Thursday, Nov. 19, at 8 p. m., preceded by the usual dinner (informal) at 6:30 p. m.

New List of Members.—A new list of members will soon be prepared for publication shortly after the beginning of next year. Any members who have made changes in their addresses, and have not notified the Secretary, should do so promptly.

Annual Medal.—The following letter has been sent to all members of the Society:

New York, Oct. 24, 1914.

The council of the Society, by letter-ballot, has decided that the subject of the award of the annual medal of the Society in January, 1915, shall be "The Advancement of the Art of Ore Dressing."

According to the rules members are now limited in their expression of opinion to that subject. However, it is still open to members to make nominations within that limitation. Members who have not already expressed their opinion are urged to do so in a communication to the Secretary.

W. R. Ingalls,
Secretary.

MEETINGS OF SECTIONS

NEW YORK.

The second meeting of the New York section for the year 1914-1915 was held at the Engineers' Club, on Thursday, Oct. 15, at 8 p. m., Sidney J. Jennings, chairman, presiding. The following members and guests were present: W. H. Aldridge, S. H. Ball, G. P. Bartholomew, E. S. Berry, Spencer Browne, R. M. Catlin, John B. Farish, N. V. Hansell, H. W. Hardinge, W. R. Ingalls, Sidney J. Jennings, J. F. Kemp, D.

M. Liddell, W. W. Mein, T. T. Read, D. M. Riordan, A. H. Rogers, E. M. Rogers, Louis Ruhl, E. G. Spilsbury, E. A. Cappelen Smith, G. C. Stone, B. F. Tillson, Gardner F. Williams, and H. A. J. Wilkens.

The following report of the Treasurer for 1913-1914 was read:

Receipts.		
Balance on hand Sept. 1, 1913		$77.00
Received from W. R. Ingalls, two-thirds cost of reporting 1912-1913 meetings	$30.00	
Received from members, cost of dinners	245.25	
Received from assessments	130.00	
Exchange	0.10	405.35
Total		$482.35
Expenditures		
Reporting meetings	$47.00	
Rent of room for meetings	73.47	
Cost of dinners	269.60	
Postage and stationery	17.42	
Telephone and miscellaneous expenses	3.08	$410.57
Balance on hand Sept. 1, 1914		$71.78
Bills payable Sept. 1, 1914		0.61
Bills receivable (two-thirds of cost of reporting meetings, 1913-1914)		31.33

B. F. Tillson read a paper on the prevention of accidents at the Franklin mine of the New Jersey Zinc Co.; Louis Ruhl made some remarks about the cyanide situation; and Sidney J. Jennings and W. W. Mein presented papers on the sampling of mines of low-grade ore.

D. M. Liddell,
Secretary of Section.

(It has been impossible to prepare the papers before the New York section for this bulletin, but they will be published in the bulletin for November.—Secretary.)

COUNCIL

Minutes of Meeting, Sept. 22, 1914.

A meeting of the council was called at the Engineers' Club, New York, on Tuesday, Sept. 22, at 5 p. m. The members present were Messrs. Kemp, Ingalls and Stone. There being no quorum, and there being no prospect of obtaining a

quorum in the immediate future, owing to the illness of several members of the council, and it being necessary to transact certain business with the least possible delay, the members present decided to proceed as if a quorum were present and submit their actions to the council for letter-ballot, by order of the President.

The Secretary reported that he had recently caused a tabulation of the membership of the Society to be made, which is of interest. The number of charter members of the Society was 115. Of these 87 are still members. The remaining 171 members have been elected. The total number of resignations has been 24; of deaths, 14. The total number of applications that failed to result in membership, either by adverse action of the executive committee, or of the council and members, is 33. One member was dropped for non-payment of dues.

The Secretary further reported that out of the lot of 50 badges that had been made up for the Society by Tiffany & Co., all had been sold except one, that being in the form of a watch-charm. The original order was for 50 badges; 30 were sold in 1912; 10 in 1913; and 9 in 1914. Consequently the Society has liquidated its whole expense on this account, except $5.

The Secretary reported that the proposed geographical distribution of the membership of the Society for the election of councillors in 1915, issued on Aug. 1, 1914, and submitted to the council for letter-ballot had been approved by Messrs. Bradley, Munroe, Ingalls, Kemp, Argall, Stone, Moore, Bain, Mudd, Goodale and Channing. A total of 11.

(The proposed distribution has already been published in Bulletin No. 75, page 129; therefore it is not repeated here.)

The President declared that a majority of the council having voted in favor of the proposed geographical distribution, said distribution was formally adopted.

The Secretary presented a file of communications from members of the Society and recommendations respecting the subject of award of the medal of the Society in 1915. After discussion of several subjects, it was voted that the subject of award of the medal in 1915 should be "Advancement of the Art of Ore Dressing."

There being no further business the meeting was then adjourned.

W. R. Ingalls,
Secretary.

Minutes of Meeting, Oct. 27, 1914.

A meeting of the council was held at the Engineers' Club, New York, on Tuesday, Oct. 27, at 5 p. m. The members present were Messrs. Kemp, Channing, Finlay, Penrose, Stone and Ingalls, a total of six, this constituting a quorum. Mr. E. G. Spilsbury was also present by invitation.

Upon motion, duly seconded and unanimously carried, the minutes of the meeting on Sept. 22, at which no quorum was present, were adopted and made part of the minutes of this meeting. The minutes of the meeting of Sept. 22 had previously been submitted to all members of the council for letter-ballot and had been approved by 13 affirmative votes, which the President announced.

The President announced that the proposal to make the subject for the award of the next annual medal of the Society "Advancement of the Art of Ore Dressing" had been submitted to all members of the council by letter-ballot, as ordered by the President. The Secretary reported that 10 members had voted in favor of that subject; and that three had voted against it. The President declared the vote and announced that a majority being in its favor, the subject of the next award of the medal would be "Advancement of the Art of Ore Dressing."

The Secretary presented a communication from H. S. Munroe resigning from the council and from membership on committees of the Society, on account of temporary inability to attend meetings. The resignation of Professor Munroe was accepted.

Upon motion, duly seconded and unanimously carried, E. G. Spilsbury was elected member of the council in place of Professor Munroe. Upon motion, duly seconded and unanimously carried, G. C. Stone was elected a member of the executive committee of the council in place of Professor Munroe.

The Secretary referred again to certain difficulties that had been experienced in the procedure in awarding the annual medal of the Society according to the existing rules. The opinion had previously been expressed by members of the Society that the procedure would be simplified if the council should first determine the subject of the award and then ask the membership of the Society to make nominations, instead of asking the membership to suggest subjects and make nominations at the same time. In the discussion of this matter in the bulletin of the Society

and at previous meetings, practically everybody had concurred in the desirability of altering the system in this respect. Consequently the Secretary offered the following substitutes for paragraphs 3 and 4 of the rules for the award of the annual medal of the Society:

3. Six months before the annual meeting of the Society, the council shall determine the specific object for which the medal shall be awarded, and four months before the annual meeting of the Society the members of the Society shall be asked to nominate candidates on a form provided for the purpose, such nominations to be accompanied by a full statement of the claims of the candidates for consideration. These nominations shall not be confined to members of the Society and may include other nationalities than our own.

4. Three months before the annual meeting of the Society, all nominations shall be considered by a committee of three to be appointed by the President. At least two months before the award this committee shall submit a list of two names to the council with a full statement of the claims of each candidate. The committee may consider and recommend names not nominated by members of the Society. The names so recommended shall be submitted to the council for election by letter-ballot.

Upon motion, duly seconded, and unanimously carried, paragraphs 3 and 4 of the rules for the award of the annual medal of the Society were revoked and the new rules offered by the Secretary were adopted.

Mr. Ingalls announced his intention of retiring from the secretaryship of the Society at the end of his present term, and related informal conferences that had taken place among himself and the President of the Society and other members of the executive committee with respect to the management of the Society's affairs after the next annual meeting. The constitution of the Society makes the secretary-treasurer, ex-officio, a member of the council. Inasmuch as there is no salary attached to the position it is necessary to elect a member of the Society who is so situated that he can give the necessary attention to its affairs, although the actual performance of most of the work must be done by an employee. During the last four years the Society has been able to take advantage of certain facilities which it will no longer have. In the future the Society can not expect to do so well in certain particulars, but must figure upon standing upon its own basis. This means, among other things, that it must rent an office of its own and must incur increased expense for the clerical assistance of the Secretary. It is estimated that after the next annual meeting the expense to the Society on these accounts will be about $1,500 per annum as against about $850 per annum (for clerical expense only) at present.

These things were discussed at length by the members present.

Upon motion, duly seconded and unanimously carried, the Secretary was authorized to incur expenses for office rent and clerical assistance in behalf of the Society up to the amount of $1,500 per annum.

Upon motion, duly seconded and unanimously carried, the Secretary was authorized to rent or lease suitable quarters in behalf of the Society.

The President announced the appointment of E. G. Spilsbury as chairman of the Committee on Annual Medal.

W. R. INGALLS,
Secretary.

COMMUNICATIONS

W. R. Ingalls.—Several members having informed me that they have voted for me to be secretary of the Society during the ensuing year, I feel that I ought to state publicly, as I have previously done privately, that I am unable to accept a renomination. This is simply for the reason that the pressure of other duties prevents me from giving so much attention to the affairs of the Society as I have during the last four years. But although I am unable to continue to serve the Society as its Secretary, my interest in its affairs will be undiminished.

MEMBERS ELECTED IN OCTOBER, 1914

Deacon, Ralph W.....Chrome, N. J.
Supt., U. S. Metals Refining Co.

Polhemus, J. H.....1009 Pierce Bldg., St. Louis, Mo.
Gen. Mines Manager, American Zinc, Lead & Smelting Co.

Mining and Metallurgical Society *of* America

Vol. VII November 30, 1914. No. 11

ANNOUNCEMENTS.

Annual Meeting.—The seventh annual meeting of the Society will be held at the Engineers' Club, New York, on Tuesday, Jan. 12, 1915. The first session will be at 2 p. m. and will be for the transaction of business. At the second session the award of the gold medal of the Society will take place. Members who can not be present at the business meeting are requested to execute the proxy which accompanies this bulletin and mail it to the Secretary in order that a quorum may be assured. This is important.

San Francisco Section.—A dinner was given in honor of the homecoming of F. W. Bradley, at the Palace Hotel, on Nov. 16. Twenty-one members and guests were present.

New York Section.—A meeting of the New York section was held at Browne's Chop House on November 19, forty-six members and guests being present. A full account of this meeting will be published in the next bulletin.

The next meeting of the New York Section will be held at 8 p. m. on Thursday, Dec. 17, 1914. It will probably be at Brown's Chop House; due notice will be given, preceded by a dinner (informal) at 6:30 p. m.

Election of Officers.—Members who have not yet voted for officers of the Society for 1915 are urged to do so without further delay. The ballot is to be canvassed on Jan. 12, 1915.

Ballot for Officers.—In conformity with the provisions of the by-laws, the following ballot was issued to all members on Nov. 13, this ballot embodying the result of the vote on nomination.

FOR PRESIDENT:

W. R. Ingalls
H. V. Winchell

FOR VICE-PRESIDENT:

F. W. Bradley
J. R. Finlay
S. J. Jennings

FOR SECRETARY-TREASURER:

F. F. Sharpless

FOR COUNCILLORS OF DISTRICT 1-2-3-4:

A. S. Dwight
W. W. Mein
A. H. Rogers
E. G. Spilsbury
G. C. Stone
A. L. Walker

FOR COUNCILLOR OF DISTRICT 8:

Philip Argall
J. W. Finch
R. A. Parker

FOR COUNCILLOR OF DISTRICT 9-10:

Albert Burch
F. G. Cottrell
M. L. Requa

The by-laws prescribe that there shall be three nominations for each office with the proviso that there may be a smaller number than three if the preliminary voting does not permit so many as three to qualify. The qualifications are that the nominees for an executive office must receive at least seven votes and for council, at least three votes.

The candidates for president who received more than seven votes were W. R. Ingalls, Hennen Jennings, J. F. Kemp and H. V. Winchell, but Mr. Jennings declined the nomination and Professor Kemp declined to take his place.

The nominees for secretary were L. D. Huntoon, W. R. Ingalls and F. F. Sharpless, but Messrs. Huntoon and Ingalls declined to accept the nomination.

In council district No. 8, Mr. J. V. N. Dorr was a nominee, but Mr. Dorr declined to accept for the reason that his legal residence is now in New York.

Members have inquired of the Secretary respecting two points of the ballot, viz., the method of marking and the matter of signature.

No regular method of marking has ever been prescribed, the tellers having recognized either a cross or check mark against the name of the candidate voted for, or the crossing off of all names but one for each office; in short recognizing any clear expression

of the intention of the voter. In the experience of seven years, the tellers have never reported any confusion resulting from this and it has been thought better to let well enough alone than to prescribe a formal method of marking.

As to signatures the directions on the ballot itself is absolutely clear, but a statement on the face of the inside envelope to the effect that "Unsigned ballots are not counted," has caused certain members to make inquiry. The statement that "ballots received in unsigned outside envelopes are not counted" would have been more precise. Neither the ballot itself nor the inside envelope containing it are supposed to have any identifying mark, the secrecy of the ballot being thus insured. The purpose of requiring the outside envelope to be signed is to determine whether it comes from a member entitled to vote and to enable the Secretary to return such vote to any member who desires to substitute another one at any time previous to the closing of the polls.

W. R. INGALLS, *Secretary.*

MEETINGS OF SECTIONS

NEW YORK

At the meeting of the New York section on Oct. 15, papers were presented by B. F. Tillson, S. J. Jennings and W. W. Mein, and Louis Ruhl made some remarks on the cyanide situation. A report of the meeting was given in the last bulletin but it was impossible to prepare the papers for publication at that time. They are therefore given in the present bulletin, together with the discussion.

The Recording of Accidents and Safety Measures Employed at the Franklin Mines of the New Jersey Zinc Company.

B. F. Tillson.—Although the following methods for the recording of accidents and the stimulation of safety measures are probably well known, yet it seems that the already voluminous amount of literature on safety work contains comparatively few references to the results which may be obtained in metal mining, and therefore, this discussion is tendered with the hope that it will encourage the interchange of ideas as to what may be accomplished in mining through interest in "Safety First" measures and will add in a small degree to the bibliography of the mining branch of safety work.

Unlike factories and other industrial establishments which have their greatest risks from moving machinery, the metal mines suffer greatly from risks such as "falls of ground," "hand-

ling explosives," "the loading of cars from chutes and subsequent tramming," etc., in which the supervision and the education of the workman are absolutely necessary for his safety since no mechanical contrivances can protect him. With the realization that any marked reduction in the number of mining accidents, and the consequent loss of time to the workmen and loss of more or less experienced labor to the company, would probably be attained by the education of the workmen in taking an intelligent interest in their own safety and that of co-workers, the New Jersey Zinc Co., in its mines at Franklin Furnace, N. J., departed this year from its former system of looking entirely to the foremen and bosses for safety and first-aid work, and instituted a plan which seems to stimulate the interest of both boss and men. It will perhaps be better to consider the details of this plan after describing the methods which had been previously employed and noting the conditions to which it applied.

The mine at Franklin Furnace, N. J., employs 350 to 450 men (excluding the mill, machine shops and power plant) and produces annually about 500,000 tons of zinc ore and about 250,000 tons of rock fill or waste. The ore is composed chiefly of the combined oxides of iron, manganese and zinc, and the silicate of zinc. The waste rock is principally a highly crystalline limestone so that the safety of the workmen is in no way endangered by the silicosis problem which must occupy the attention of many of the Western metal mines.

Shrinkage methods of stoping are in general employed to mine the ore and the property is cross-sectioned by the stope-slices (whose widths are 17 ft. and lengths equal to the horizontal distance across the orebody), with ore pillars of an average of 35 ft. left standing between each stope slice. As a rule, the mining of ore in stopes is carried upward a height of 50 ft., with sufficient of the broken ore left in the stope for an upper surface to be about 6 ft. from the solid back on which the miners are working; then the broken ore is drawn out, timbers recovered, and waste rock packed into the empty chamber up to the elevation of the level above. Set timbers are then placed on the rock filling and the mining of the ore continues on top of these timbers for the progress of the stope another lift; and so the stope slices progress upward from the bottom of the orebody. In the future the remaining intermediate pillars of ore will be recovered by some caving systems of mining, starting at the upper portion of the orebody and working downward.

The New Jersey Zinc Co. has for six years had its own hospital with the staff of a surgeon, a head nurse, four nurses,

an orderly and two domestics. The hospital is modernly equipped for minor and major operations and X-ray work, has four private rooms and a wardroom, accommodating five patients, and is equipped with an automobile ambulance.

The company provides a Neighborhood House with its director, visiting nurses and teachers to look after the sociological needs of the community and provide clean recreation. For over six years the mine has been equipped with three Fleuss oxygen-breathing apparatus for mine-rescue work and the shift bosses and foremen have been instructed in the use of this apparatus, but fortunately there has been no need of earnest work with it; and the Draeger pulmotor has been a part of the equipment for over three years and has, so far, been unnecessary.

Until the beginning of this year the active first-aid and safety work devolved entirely upon the foremen and bosses who were trained in bandaging and the general principles of first-aid work and administered as was necessary until delivery of the injured man at the hospital. It was naturally a boss's duty to supervise the proper and safe performance of the work done by each man in his gang and we felt that our shift bosses were more than ordinarily interested in the protection of their men. Yet we appreciated that failing in human nature which prompted a supervisor to feel that the results of an accident due to disobedience of explicit directions or due to crass stupidity were amply deserved and did not excite sympathetic interest if no serious disability or fatality occurred. For instance, I recollect that at one time there seemed to be an epidemic of men pulling tram cars directly upon their own feet which were run over by the car wheels, and it was naturally difficult for the shift bosses to get the same attitude toward their men as a governess has toward her ward, for those who work in a mine are supposed to exhibit the discretion and common sense of maturity. However, that such is not the case is shown by the following examples:

At a certain point on one of our main underground electric haulage tracks, where the overhead weight made timber sets necessary with the posts close to the clearance of the cars, several accidents occurred from men trying to stand between the posts and the cars instead of passing behind the posts where there was plenty of room. To overcome a repetition of these accidents, we delegated a workman to be stationed at this point to keep men from such an accident, and lo, he was the next one so injured!

Just recently an experienced miner performed an act so

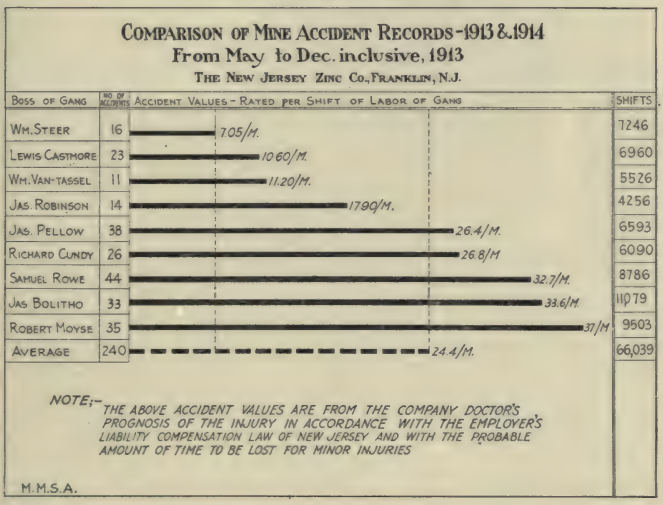
lacking in common sense that it seems unaccountable. Contrary to orders he mounted his rock drill to deepen a drill hole of the round he had fired the previous day but had not broken its burden, and as a result some of the dynamite which remained in the hole was ignited by the percussion of the drill steel or the sparks which it made against the rock, and the explosive burned with fumes which drove the miner from the working place but did not injure him. Upon his return to this working place he again placed the drill steel in the same hole and some of the explosive which remained from the burning this time exploded and peppered the miner's face with rock and will probably cause the loss of an eye.

So in order to stimulate the shift bosses with zeal and close attention in their safety supervision as would be expected in the attitude of a kindergarten teacher toward her pupil, we offered in April, 1913, a prize of $200 at the end of the year to the mine shift boss or timber boss having the best record for freedom from serious accidents, whose value was rated by the company's doctor in accordance with his prognosis rated against the total shifts of labor supervised by that boss. The table of prognosis values was formulated with due regard to the relative values of fatalities, total disabilities and major injuries as shown in the New Jersey employers' liability and compensation laws, and the probable length of time of disability was considered in setting values for minor injuries. The following table is a list of injuries and the values applying to them, among which is a demerit of 50 points for the failure of a boss to report an accident.

VALUATION OF INJURIES FOR SAFETY WORK.

Diagnosis	Length of Disability	Numerical Basis
Loss of life		200
Total disability		200
(a) Loss of both eyes		
(b) Loss of both arms		
(c) Loss of both legs		
(d) Broken back		
Loss of arm or leg		150
Loss of eye		125
Fracture of Femur	3 months	100
Compound fracture of arm or leg	3 months	100
Loss of thumb or big toe		75
Simple fracture of arm or leg	2 months	60
Loss of fingers or toes		50
Injuries of joints	1-4 weeks	7— 30
Lacerated wounds	1-3 weeks	7— 30
Contusions	1-2 weeks	7— 15
Abrasions	1-10 days	1— 10
Scalp wounds	1-10 days	1— 10
Dislocations	2 weeks	15
Failure to report accident		50

Although we realized that chance played an important part in the winning of this prize, inasmuch as many accidents have the same potentialities but result in sometimes trivial and sometimes serious injuries, nevertheless, in view of the fact that the failure of a boss to win reward did not deprive him of anything which he had previously enjoyed, it seemed such a prize would prove a stimulus to devote attention to safety work so as to improve their chances of winning. It was gratifying to note that



this prize went to a man whose work lay in a comparatively hazardous territory, so far as treacherous ground was concerned, and also fell to a man who was conspicuous in his interest and precautions for safety.

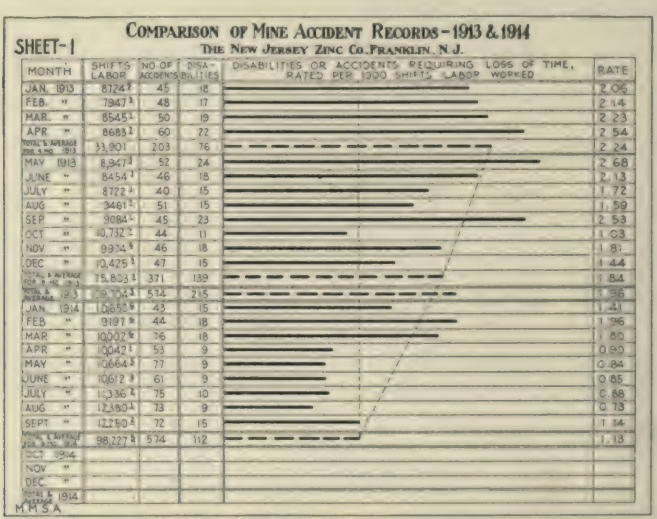
The accompanying plate shows the comparative standing of mine bosses, contesting for the above prize, and sheets 1 and 2 show graphically that during the last eight months of 1913, when this prize system was operative, accident prevention compared most favorably with that of the first four months of the year, when no such plan was in operation, for—

(1.) The number of accidents per 1,000 shifts of labor worked has fallen from 6 to 4.9, or a reduction of 18.30% under the prize scheme.

(2) The number of disabilities (accidents requiring any loss of time subsequent to the date of injury) per 1,000 shifts of labor has fallen from an average, for the first four months of the year 1913, of 2.24 to an average of 1.84 for the last eight months, or a reduction of 17.8%.

(3) The shifts of labor lost owing to the disabilities of accidents rated per 1,000 shifts of labor worked in mines were 18.35 as an average of the four months previous to the above plan and averaged 17.30 afterwards for the next eight months, and showed a decrease of 5.7 per cent.

(4) There were, during the first four months, only three



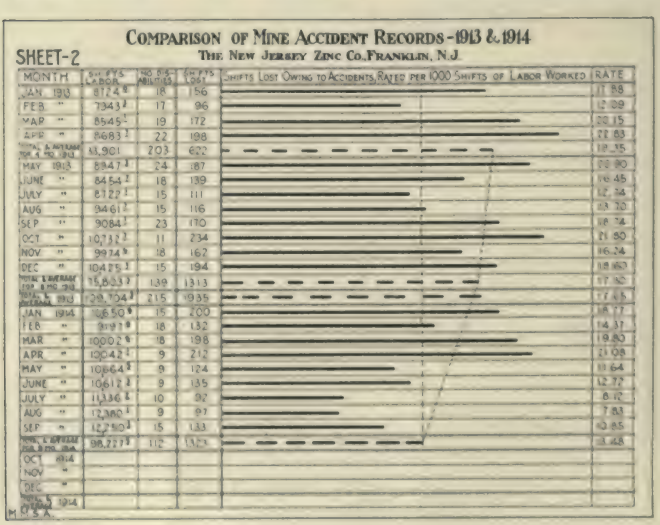
COMPARISON OF MINE ACCIDENT RECORDS - 1913 & 1914

SHEET-1

THE NEW JERSEY ZINC CO. FRANKLIN, N.J.

MONTH	SHIFTS LABOR	NO. OF ACCIDENTS	DISABILITIES	DISABILITIES OR ACCIDENTS REQUIRING LOSS OF TIME, RATED PER 1000 SHIFTS LABOR WORKED	RATE
JAN. 1913	8724	45	18		2.06
FEB. "	7947	48	17		2.14
MAR. "	8545	50	19		2.23
APR. "	8683	60	22		2.54
TOTAL & AVERAGE FOR 4 MOS. 1913	33,901	203	76		2.24
MAY 1913	8,347	52	24		2.68
JUNE "	8454	46	18		2.13
JULY "	8722	40	15		1.72
AUG "	9461	51	15		1.59
SEP "	9084	45	23		2.53
OCT "	10,732	44	11		1.03
NOV "	9974	46	18		1.81
DEC "	10,425	47	15		1.44
TOTAL & AVERAGE FOR 8 MOS. 1913	75,803	371	139		1.84
TOTAL & AVERAGE 1913	109,704	574	215		1.96
JAN. 1914	10,650	43	15		1.41
FEB. "	9197	44	18		1.96
MAR. "	10002	76	18		1.80
APR. "	10042	53	9		0.90
MAY "	10664	77	9		0.84
JUNE "	10612	61	9		0.85
JULY "	11,336	75	10		0.88
AUG "	12,380	73	9		0.73
SEPT "	12,750	72	15		1.14
TOTAL & AVERAGE FOR 8 MOS. 1914	98,227	574	112		1.13
OCT. 1914					
NOV "					
DEC "					
TOTAL & AVERAGE 1914					

M.M.S.A.



COMPARISON OF MINE ACCIDENT RECORDS - 1913 & 1914

SHEET-2

THE NEW JERSEY ZINC CO. FRANKLIN, N.J.

MONTH	SHIFTS LABOR	NO. OF DISABILITIES	SHIFTS LOST	SHIFTS LOST OWING TO ACCIDENTS, RATED PER 1000 SHIFTS OF LABOR WORKED	RATE
JAN. 1913	8724	18	156		17.88
FEB. "	7343	17	96		12.09
MAR. "	8545	19	172		20.15
APR. "	8683	22	198		22.83
TOTAL & AVERAGE FOR 4 MOS. 1913	33,901	203	622		18.35
MAY 1913	8947	24	187		20.90
JUNE "	8454	18	139		16.45
JULY "	8722	15	111		12.74
AUG "	9461	15	116		13.70
SEP "	9084	23	170		18.74
OCT "	10732	11	234		21.80
NOV "	9974	18	167		16.74
DEC "	10425	15	194		18.60
TOTAL & AVERAGE FOR 8 MOS. 1913	75,803	139	1313		17.30
TOTAL & AVERAGE 1913	109,704	215	1935		17.65
JAN. 1914	10650	15	200		18.77
FEB. "	9197	18	132		14.37
MAR. "	10002	18	198		19.80
APR. "	10042	9	212		21.08
MAY "	10864	9	124		11.64
JUNE "	10612	9	135		12.72
JULY "	11,336	10	97		8.52
AUG "	12,380	9	97		7.83
SEP "	12,750	15	133		10.85
TOTAL & AVERAGE FOR 8 MOS. 1914	98,227	112	1323		13.48
OCT. 1914					
NOV "					
DEC "					
TOTAL & AVERAGE 1914					

M.M.S.A.

gangs, totaling 2469.4 shifts of labor, who had perfect freedom from disabilities, while during the last eight months there were twelve gangs, totaling 9126 shifts, who had perfect scores; therefore, the scores in the latter period of time were about four times as good as in the former.

However, it seemed that we could improve on the lump sum reward by making the prize a monthly rather than an annual one, and thus reduce the element of chance in affecting throughout the entire year the reward of a man who has been zealous in his safety work and has shown excellent records for most of the months only to have the misfortune of the spoiling of his chances by some serious but unpreventable accidents in one or two months. Furthermore, we abandoned the elaborate evaluation of accidents by prognosis of injuries for several reasons:

(a) The same latent potentialities exist in the causes of many accidents whose resulting injuries are widely diverse in seriousness, so that the factor of fortune or misfortune affected the score too vitally.

(b) The personal element of a doctor's prognosis is often embarrassing to him as he feels he must be on guard not to show any favoritism.

(c) The clerical labor involved must to a great degree be borne by the doctor who could spend his time to better advantage.

To improve upon the $200 annual lump prize plan we arranged for a monthly distribution of a $10 bonus to each underground timber boss or shift boss who, during 1914, had less than 1.20 disabilities per 1,000 shifts of labor worked in his gang each month; and this rate was made arbitrarily as one which was capable of attainment but indicative of considerable improvement in safety work. Such a scheme has an impulse for safety which is ever present, since it means that a boss can usually increase his salary 10% by devoting his spare time and interest in the continual education and training of his men in safety measures, and encourages him to persist in his instruction of the stupid and ignorant, as well as disciplining of the careless and disobedient. That such has been the case is shown by consideration of the number of bonuses which would have been paid in the two periods of 1913 and until Oct. 1, 1914, if such a monthly bonus rating had been operative for that entire period of time. During the first four months of 1913 eight bonuses would have been paid out of a possible 32, or the standing was 25% "hits"; and in the latter eight months of the year 26 bonuses would have been paid from a possible 64, or the standing was

40.7% "hits." During the first nine months of 1914 we have paid 46 bonuses out of a possible 80 and the record of achievement shows that our bosses are now succeeding 57.5% of the time, also that 29 times out of the 46 there were no disabilities or 36.3% of possible shots were "bull's eyes."

But a teacher rarely accomplishes much without the co-operation of his pupil, and neither will a boss be able to train his labor in safety methods without their interest; so the scheme was inaugurated in January, 1914, of making a monthly rating of the number of shifts of labor lost through accidents (rated per 1,000 shifts of labor worked) in each gang of the underground and surface mining operations; and of that gang, respectively, having the best record each month each member was rewarded with a cigar, specially marked so as to denote that it had been given by the New Jersey Zinc Co. for excellence in safe work. Although our mine labor was about 90% of such nationalities as Russians, Poles, Slavs, Lithuanians and Hungarians, it was encouraging to note the pleasure and interest evinced by the men who received these cigars and their pride and understanding in regard to the matter. That this distinctive token means something to the men is shown by the fact that during the first nine months of 1914 there have been 29 gangs of the 80 underground gang-months, who have won the cigars by a clean record with no loss of time through accident, although 26,289 shifts of labor were worked; and in addition there were 11 open-cut gangs who won cigars, of which nine gangs had a clean record with 5,839 shifts of labor. So there were 38 gangs of men in the mine during January to October, 1914, who worked 32,128 shifts in 232 working days, or the equivalent of about 138 men worked for nine months, grouped in gangs, without loss of time from accident. In 1913 there were about one-half as many gangs with perfect "no lost time" records in 12 months, and less than half as many shifts of labor were included in these gangs; so there has been an improvement in 1914 of about 250% of 1913.

As a result of this personal stimulus there has been a conservation of the laborer's earning powers with profit to his home, and, on the other hand, the employer has greatly benefited because there have been fewer changes in the personnel of his plant with the consequent loss of time, production and efficiency.

In conjunction with the bonus schemes just described other means were taken to educate the men in safety and first-aid work, and to impress the men with the knowledge that the company was doing its utmost to protect them, and that in order to succeed they must use such safeguards as were furnished by rules, instructions and mechanisms. In the mining department

a first-aid corps of eight members was formed by the appointment by the mine foreman of two new members bi-weekly to succeed two retiring members. This corps meets once a week to receive instruction from the company doctor and its members are paid their regular hourly rate for such time. At the end of the eighth week of service membership expires, and if the doctor considers a retiring member proficient the latter receives a first-aid badge as a mark of his eligibility to serve in the Workmen's Safety Committee. The above apprentice course does not pretend to fit a man for the handling of accidents in the mine and he is not given access to the emergency kits in the different shift bosses' territories, but it does intend interesting him in the proper care of himself and others and not only furnishes an index of the men who will prove most helpful as an influence for good on the Workmen's Safety Committee, but also forms a basis for the organization of first-aid and rescue teams in the different territories so as to assist the shift bosses in the care of accidents. During the first nine months of 1914 there have been 41 qualified graduates of the first-aid committee and the formation of rescue teams is in hand, with the idea of training them so thoroughly as to warrant their access to emergency kits and care for the injured who come to their notice. These men will receive training in fire fighting, oxygen helmet rescue work and competitive drills, and it is hoped that frequent prize competitions among themselves and with foreign plants will keep their interest alive.

The members of the Workmen's Safety Committee are appointed, two bi-weekly, by the head of the mining department and serve four weeks, holding weekly meetings with the department head, or his representative, to discuss the nature of the accidents which have occurred the previous week and to take a tour of inspection through some portion of the mine, thus devoting an entire shift. Suggestions are encouraged from the men but probably the most important results are due to their education and prompting of interest in the protection of themselves and others, as well as to the subtle spur to the supervision of the bosses, caused by the inspection and possible criticism of their territories by a workmen's committee. Each member is active for four weeks and then exchanges his active badge (showing a red enamel border) for an exempt one (with a blue enamel border), but receives his usual pay for time devoted in active service; and is privileged as an active member to attend the scene of an accident, in the interests of safety work, when his absence from regular work does not cause injury to company

property or working operations. When any serious accident takes place the Safety Committee visits the scene to discuss causes and remedies and the committeemen are asked to spread the news to the other workmen of how the accident took place so that they may profit by the example and, if the accident was preventable, avoid the same pitfalls. The exempt members of the Workmen's Safety Committee are requested to take an active interest in safety work and to contribute suggestions to the safety suggestion box, also to caution any workman endangering his own safety or that of any one else.

The heads of departments are expected to make quarterly tours of inspection throughout the entire plant, accompanied if possible by a safety inspector from some other plant, and then hold a meeting to discuss any improvements and receive suggestions of practices elsewhere as noted by the department heads or visiting safety inspector.

Although we have hopes of supplementing this safety campaign by frequent stereopticon and moving-picture lectures showing safe and dangerous practices, we have not as yet found a sufficient supply of such material pertinent to metal-mining practices to insure the proper development of a series of lectures.

It is noticeable that our safety organization does not require the formation of a special safety department, but places the responsibility upon the heads of departments with the expectation that they will exhibit the same zeal in safety as they do in production. In this way are avoided many occasions of staff friction between operating and safety control; and the work of the company is accomplished more efficiently because there is no division of authority in any department, and because the head of operations is best qualified to select the proper time for taking safety measures without undue increase of floating gangs and without waste of time. The success of this scheme really depends upon the earnestness of "the man higher up," for if he requires of his subordinates the same interest and results in safety work as he expects in production the returns will be comparable.

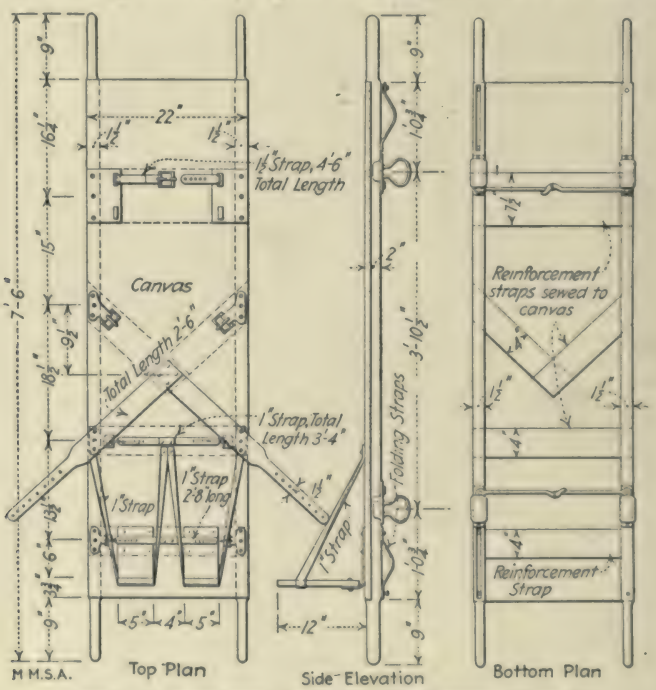
In order to work intelligently in the development of safety work it is highly important that each department head have sufficient clerical aid to attend to the routine of bulletins, the abstracting of safety literature, and most especially the recording of all accidents, with classification of their causes, of their disposition among the various gangs, and of the number involving loss of time and the amount of time so lost. Our system of recording accidents is as follows, and we feel that we have

obtained, during 1914, knowledge of almost all the accidents, including trivial ones such as grazed knuckles, and are sure that at least 30% more have been reported than in the previous year.

Blanks are furnished to the shift bosses for them to fill out with the following information concerning injuries sustained by any workmen of their gangs. These show whether they were injured in company work or off shift, stating particularly if the latter condition existed, so that the company will have information to disprove fraudulent claims for injuries in their employment; and give name, pay roll number, address, age, occupation, place where accident occurred, date and hour of accident, where taken after accident, supervisor of the work, witnesses, description of the injury, manner in which the accident happened, and suggestions as to how it might have been avoided. These reports are kept by the mine foreman, who investigates the matter and makes a copy of the report, which is then forwarded to the time office where information is entered as to weekly wages, weekly rate of half-time, nationality, length of time man had been employed at the work in which he was injured, how long he had been in the service of the company, and as to whether he was married or single; and the report is then sent to the main plant office where the above information is typewritten in duplicate on large accident report sheets and these are supplied with the added information of: the probable length of disability (shown by the surgeon's prognosis), and the actual time of disability shown on the pay roll sheets, also the dates that claims and settlements are made and their amounts, also the dates and amount of "surgeon's charges," "hospital charges," "sundry charges," and "compensation," and the "total burial expenses" and "total expenditures" are finally given. One of these reports is kept on file in the main plant office and the copy is sent to the main company office. The State of New Jersey requires the immediate reporting of accidents to the Department of Labor at Trenton on a special form.

The shift bosses are also equipped with forms admitting men to hospital service and these they fill out with the date, name, pay-roll number and occupation of any man injured in company work, no matter how slight the injury. In case of serious injuries first aid is given, stretchers of the type here illustrated are employed if necessary, and the injured men are sent immediately to the hospital in the company's automobile ambulance. However, if the injuries are so slight as not to incapacitate the men, bandaging is performed by the shift boss (who carries in a tin tube on his person sterile roller bandages and gauze pads) and the men receive their hospital slips at the

end of the shifts. Since the hospital has dispensary hours at night as well as day it is possible for men to report there for the inspection and dressing of wounds without interfering with attendance to work and the shift bosses permit no men to return to work until they bring hospital discharge slips from the company surgeon bearing the dates when they are considered fit for work. Thus the responsibility for the cleanliness of wounds, however slight, and resulting cases of blood poisoning, is placed where it belongs, directly upon the surgeon, and he has control



TYPE OF STRETCHER USED BY NEW JERSEY ZINC CO.

over the injured men since they cannot get work until he has had an opportunity for a final examination of their injuries and has formally discharged them. The shift bosses' supervision of the steadiness of their workmen is also aided as they can note whether men have stayed away from work longer than their injuries warranted and can fairly exercise such discipline as seems proper. This system of reporting accidents seems quite efficient, for the shift bosses do not rely solely upon the voluntary reports of their men but also question and report any man

who exhibits an injury, and if a man fails to report his injury it usually becomes known ultimately and results in the severe disciplining of such man by laying off from work for a period of time or else by his dismissal.

In classifying accidents as to their causes we have adopted the heading employed by the U. S. Bureau of Mines in its accident reports and the accompanying table shows the comparison for 1912, 1913 and the first nine months of 1914, during which period we have amplified its classification of "Killed," "Seriously Injured" (with disability of 20 days or more), and "Slightly Injured" (with disability of from 1 to 19 days), by the added group of "Trivially Injured," which includes all accidents in which men returned to work the day following the accident. It should be noted that two systems of safety work have been tried since 1912, as has been previously described, and the results have been very gratifying, for in 1913 the decreases in accident rates per 1,000 men employed for a year of 300 days were as follows:

	Fatal	Serious	Slight
Underground Mining	38%	42.7%	52.9%
Surface Mining	100%	(Increase)	66.7%
Total Mining	61.6%	40.8%	55.5%

Since the changes in safety organization made at the beginning of 1914 the results have been still more gratifying, for the accident rates now show a considerable decrease from those in 1913 as the following percentages demonstrate.

Decrease of accident rates in the average of the first nine months of 1914 as compared to the average of 1913:

	Fatal	Serious	Slight
Underground Mining	57.3%	21.6%	41.4%
Surface Mining	(none possible)	67.0%	22.6%
Total Mining	61.6%	30.8%	44.8%

But still more marked is the reduction of accident rates shown by comparison of 1914 with 1912 and it should be remembered that the comparison would be more marked if the figures for the period of safety work did not include the first four months of 1913 when such work had not been inaugurated, and if the safety movement had been in progress for a period of time longer than 17 months.

The following percentages exhibit the decrease of accident rates, as based on 1,000 employes for a 300-day year, from December, 1912, to October, 1914:

	Fatal	Serious	Slight
Underground Mining	73.7%	55.2%	71.7%
Surface Mining	100%	(Increase)	74.3%
Total Mining	85.2%	59.2%	75.3%

MINE ACCIDENT RECORD FOR 1914

		R. J. Moyse	Wm. Steer	Total Under-ground	Surface and Misc'l's.	Total Open Cuts	Grand Total Mining
January	No. of accidents	10	3	44	0	1	45
	No. requiring loss of time	6	1	18	0	0	18
	Time lost by accidents	40 + (0)	10 + (0)	85 + (71)	0	0	85 + (71)
	Shifts labor worked	910.1	912.1	6817.1	665.2	1242.2	8724.5
	Lost time, accidents rated per 1000 shifts labor worked	6.60	B. 1.10	3B. 2.64	0	0	2.06
	Time lost by accidents per 1000 shifts.	43.90	10.97	12.46	0	0	9.75 *17.88
February	No. of accidents	5	4	43	1	4	48
	No. requiring loss of time	2	2	14 + 2F	0	1	15 + 2F
	Time lost by accidents	13 + (0)	2 + (0)	63 + 3F + (32)	0	1	64 + 3F + (32)
	Shifts labor worked	965.4	795.3	6295.6	620.2	1031.3	7947.3
	Lost time, accidents rated per 1000 shifts labor worked	2.07	2.52	1B. 2.54	0	0.97	2.14
	Time lost by accidents per 1000 shifts.	13 48	2.52	10.00	0	0.97	8.06 *12.09

* Time lost by accidents per 1000 shifts labor, including lost time caused by accidents of previous months.

Not all the individuals foremen's records are given; therefore the totals are not the sum of the individual columns.

Notes: Figures in brackets give time time lost by accidents in previous months. "B" means bonus given. 3B in January means three bonuses given for the month. "F" means fatal accidents. "P" (none shone in the two months chosen as examples), permanent disability.

It is possible that some credit for the above reduction in accident rates is due to a change in July, 1913, from a 10-hour to an eight-hour working shift with a chance of a laborer becoming less fatigued and careless from such a condition, but on the other hand, the system of reporting accidents now is so improved over the old methods that the actual decrease in serious and slight accidents must have been even greater than the above figures indicate.

In order that the mine foreman and his assistants may be conversant with the causes of accidents which need the most attention, they keep a chart showing a list of the various classifications with columns ruled for the shift bosses and so keep an open list for each month of the fatal, serious, slight and trivial accidents credited to each boss's supervision. Such information is summarized on sheet 3 and the percentage of various accident causes show "falls of rock or ore" to be the most serious with accidents from "haulage or tramming" next in importance, and the "falls of persons down chutes, raises, and stopes" third. The "handling of timber and hand tools" has sometimes been a source of serious accident but plays a more important part in the causing of slight injuries, where it is rivalled by "runs of ore from chutes and pockets" and by "drilling operations." These respective positions of importance compared very similarly to those noted by the U. S. Bureau of Mines as applying to the metal mines of the country and we are gratified that at last our fatality rate has fallen to 3.06, a point below the average of either the coal or metal-mining industries, whose rates were quoted as 4.36 and 4.09, respectively, for 1912, which is the latest for which the Bureau of Mines has published figures. It is only fair to the record of fatalities and serious injuries to call attention to the fact that this mine is in an orebody which possesses the peculiar and unusual condition of a state of internal stress, so that ground which appears and sounds solid to all tests will suddenly crack with an explosive noise and will fall in masses from a fraction of a pound to many tons in weight, therefore the accidents from "falls of ore and rock" are extremely hard to control.

I might add that I think this Society should try to influence the Bureau of Mines to report accidents in some other way than a distribution by states. If accidents were classified according to mining methods, for example, those occurring in square-set mining, in caving, shrinkage stoping, and opencut work, we should then have a record which we might use to advantage in comparing the work at various mines.

Comparison of Mine-Accident Records 1912, 1913 and 1914

THE NEW JERSEY ZINC CO., FRANKLIN, N. J.

Analysis of Mining Dept. Accidents...	1912						1913						Jan.-Oct., 1914					
Number and per cent. of underground men killed or injured	Killed		Injured				Killed		Injured				Killed		Injured			
			Seriously		Slightly				Seriously		Slightly				Seriously		Slightly		Trivially	
By fall of rock or ore from roof or wall	3	75%	8	30.8%	57	17.5%	3	100%	4	22.2%	30	16.1%	..	.....	3	27.3%	11	13.0%	33	7.8%
By rock or ore while loading at working face	..	.....	..	.....	...	.....	..	.....	..	.....	7	3.8%	..	.....	..	.....	1	1.2%	1	0.2%
By timber or hand tools	..	.....	4	15.4%	75	23.0%	..	.....	3	16.7%	39	21.0%	..	.....	1	9.1%	18	21.2%	121	28.7%
By explosives	..	.....	1	3.9%	2	0.6%	..	.....	2	11.1%	1	0.5%	..	.....	2	18.2%	1	1.1%	1	0.2%
By hauling (mine cars, locomotives, breaking of rope, etc.)	..	.....	5	19.2%	47	14.4%	..	.....	5	27.8%	29	15.6%	..	.....	2	18.2%	12	14.1%	69	16.3%
By falling down chute, winze, raise, stope, etc.	1	25%	3	11.5%	10	3.1%	..	.....	1	5.6%	6	3.2%	1	100%	1	9.1%	13	15.3%	16	3.8%
By run of ore from chute or pocket	..	.....	5	19.2%	98	30.1%	..	.....	1	5.6%	49	23.6%	..	.....	1	9.1%	12	14.1%	92	21.8%
By drilling (machine or hand drills)	..	.....	..	.....	28	8.6%	..	.....	..	.....	15	8.1%	..	.....	..	.....	11	13.0%	34	8.2%
By machinery (pumps, hoisting engines and haulage)	..	.....	..	.....	4	1.2%	..	.....	1	5.5%	7	3.8%	..	.....	..	.....	..	.....	...	.....
By stepping or falling on nail or spike	..	.....	..	.....	...	.....	..	.....	..	.....	1	0.5%	..	.....	..	.....	1	1.1%	5	1.2%
By sledging chunks and mucking	..	.....	..	.....	5	1.5%	..	.....	1	5.5%	2	1.1%	..	.....	1	9.0%	5	5.9%	50	11.8%
Total	4	100%	26	100%	326	100%	3	100%	18	100%	186	100%	1	100%	11	100%	85	100%	422	100%
Rate per 1000 employes on 300-day-year basis	14.55		94.6		1188		9.03		54.2		560		3.86		42.5		328		1630	
Per cent. decrease in underground accident rates	....		....		....		38.0%		42.7%		52.9%		57.3%		21.6%		41.4%		.....	

Number and per cent. of surface men killed or injured																				
By falls or slides of rock or ore	1	.....	..	.....	2	.....	..	.....	..	.....	3	.....	..	.....	..	.....	..	.....	1	2.4%
By haulage (cars, locomotives, etc.)	..	.....	..	.....	...	.....	..	.....	..	.....	1	.....	..	.....	..	.....	..	.....	6	14.3%
By falls of persons	1	.....	..	.....	...	.....	..	.....	2	.....	...	.....	..	.....	..	.....	..	.....	7	16.7%
By timber or hand tools	..	.....	..	.....	4	.....	..	.....	..	.....	2	.....	..	.....	..	.....	1	14.3%	20	47.6%
By drilling	..	.....	..	.....	...	.....	..	.....	..	.....	...	.....	..	.....	..	.....	1	14.3%	3	7.1%
By mucking	..	.....	..	.....	...	.....	..	.....	..	.....	...	.....	..	.....	1	.....	5	71.4%	5	11.9%
Total	2	100%	..	.....	6	100%	..	.....	2	100%	6	100%	..	.....	1	100%	7	100%	42	100%
Rate per 1000 employees on 300-day year basis	133.3		....		400		....		44.4		133.2		....		14.7		103		617	
Per cent decrease in surface accident rates	.....		....		....		100%		....		66.7%		....		67.0%		22.6%		....	
Grand total mining	6		26		332		3		20		192		1		12		92		464	
Total mining rate per 1000 employees, 300 days	20.70		89.70		1145		7.96		53.10		509		3.06		36.70		281		1420	
Per cent. decrease in total mine accident rates	.....		....		....		61.6%		40.8%		55.5%		61.6%		30.8%		44.8%		....	
Number of accidents without disabilities and total accidents	131			495			359			574			464			569				
Rate of total accidents per 1000 employees, 300 days	1707						1222						1740							
Number of days mine was operated	300						307						232							
Average number of men underground per day	275						324						335							
Average number of men, day, surface, excluding office	15						.44						88							
Length of working shift in hours	10						10 from Jan.-June; 8 from July-Dec.						8							

The Chairman.—Returns by states are required by our system of individual state sovereignty. If another plan were adopted, there would be an immediate outcry from all the state senators and representatives.

Mr. Catlin.—Returns could still be classified by states, and also by systems of mining.

The Chairman.—The classification headings would still give trouble. An outsider might think that a particular mine was operating under a system shown by the records to be hazardous, while the owner would believe that his mine should be entered in a safer group.

Mr. Catlin.—If the accident statistics were differently classified they would be more helpful; they are not now of great utility.

I wish to state here that most of the credit for the improvement at the Franklin mine is due to Mr. Tillson. I must admit that at first I didn't think much of his "safety-cigar" idea. I thought it, so to speak, making light of a grave subject, and I did not altogether approve of it; results have proved me wrong.

Mr. Ingalls.—Mr. Fay, of the Bureau of Mines, has told me that he is going to inaugurate the system of which Mr. Tillson speaks. This will be started as soon as possible.

Mr. Mein.—Has Mr. Tillson investigated safety catches in inclined shafts?

Mr. Tillson.—I know that subject only through reading the Transvaal reports.

Mr. Catlin.—The only reliable safety device in an inclined shaft is a good rope.

Mr. Mein.—The law of Canada requires one to use a safety catch of approved design.

Mr. Catlin.—Legislators are often unfamiliar with working conditions. There are many foolish laws; this may be one of them. Can any one refer me to statistics showing, in terms of tonnage, what a rope may be expected to do? For instance, we have discarded some apparently good ropes, put on four years ago, because we thought they had done enough. It has always seemed to me that an electrical method ought to be devised for testing the continuity of the wires in a hoisting rope. Electricians all say that this is perfectly easy, but they do not explain how. One firm offered to furnish the apparatus, for a certain sum, but did not furnish it. One would suppose that if the

break in an Atlantic cable can be exactly located from shore, it ought to be possible to use a similar method for a 2,000-ft. hoisting rope. Will not a broken strand be indicated by decreased conductivity, by diminished capacity for magnetic induction when the rope is passed through a magnetic field? Could not some way be devised by which a broken wire would record itself? The signal might be visual, it need not necessarily be an audible one.

Mr. Jennings will remember an accident at Robinson Deep. The rope had been in service but a few months; it was not impaired by rust, yet the rope simply parted. It was claimed to be a new kind of steel; nothing equal to it. Mr. Caldecott made some experiments on a piece of this rope 2 ft. long. This 2-ft. piece he cut into two equal parts, and put one piece in an acid bath of twice the acidity of mine water; the wire was then tested. A strand was selected, clamped, and a 50-lb. weight was suspended by it. This weight was then rotated; the original wire broke on the 42d turn, the treated wire on the fourth. The diminution in section of the treated wire was so slight that it could not be ascertained by calipering, though Mr. Caldecott calculated it by ascertaining the amount of dissolved iron in the acid bath. One fracture was bright, as though cut with a lathe, the other, irregular. The break was not due to diminution in the section of the rope, but to occlusion of hydrogen, forming a brittle alloy. This was ascertained by boiling the wire, and collecting the gas from it. Also, after this boiling, the wire returned to its original strength. However, all I intended to say was that the best safety device in an inclined shaft is a good rope.

The Chairman.—We have here to-night Mr. Ruhl, of Roessler & Hasslacher, who has consented to tell us of the possibility of supplying the cyanide demand of the United States and Mexico.

The Cyanide Situation.

Mr. Ruhl.—I really did not expect to speak to-night, and have not prepared an address, therefore can only make a few general remarks on the present cyanide situation; all well-known history.

Our firm began the manufacture of cyanide in this country in 1890, at Perth Amboy, N. J., making the first potassium cyanide of 98 to 99% guaranteed purity, by the old method from potassium ferro-cyanide, using both domestic and foreign raw materials, the latter permitting us to export cyanide made in the United States to Mexico and other Central American countries.

It was seven years before we sold the first carload at 45c. per lb., a most memorable event, although we were told, after the success of the cyanide process in the Transvaal was assured, that cyanide would be wanted here also, by the carload, every hour of the day. The first carload was not sold for gold extraction, but for the fumigation of orange trees, the only recognized remedy against the San José pest.

Among our first customers were the Mercur gold mines at Mercur, Utah, and the Brodie cyanide plant at Cripple Creek, Colo., where I first met your Secretary, Mr. Ingalls. Capt. J. R. Delamar placed the first carload order for the Nevada Gold Mines, which he had just acquired, after his failure with the Rothwell chlorination process. The Captain only then came to the conclusion that cyanide in its concentrated form was by far a better material to transport than chloride of lime, in large, bulky casks, as the contents of these casks of his first supply were strewn all along the 175 miles from the Milford railroad station to his mine at Pioche, Nevada.

Capt. Delamar started with 6 to 8 lb. of cyanide for each ton of ore, the value of the ore at that time being $60 in silver and $15 in gold per ton. As he was anxious to recover the precious metal, he did not mind how much cyanide was used so long as he could secure big results, but it also did not take him long to discover that he was wasting cyanide. The price at which we sold him the first 100 tons was 32½c. per lb., f. o. b. New York.

We tested the feed and the tailings of the Nevada Gold Mines and advised the neutralization of the ore with lime or caustic soda before cyaniding, which would cut down the consumption of cyanide to 4 lb. per ton of ore. Several years later the Captain's manager, Hartwig A. Cohen, openly boasted of having reduced the consumption of cyanide to 1 lb. per ton of ore, but failed to mention that the refractory ores had fallen in value to $10 per ton.

With the enactment of the Dingley Tariff Act of 1897, reducing the rate of duty from 25 to 12½% *ad valorem*, we were compelled to cease the manufacture of potassium cyanide. For several years, during the period of the Transvaal war, we resorted to the importation of cyanide.

In 1902 we took up the manufacture of sodium cyanide, producing it synthetically, according to an invention of an American chemist, Mr. Hamilton Y. Castner. It took fully 10 years to reach the high standard of sodium cyanide which we are now producing, equivalent to 128 to 130% potassium cyanide, now

universally recognized as the only proper material for electroplating, fumigation, and gold extraction purposes.

Unfortunately for the United States mining industry and ourselves, after the enactment of the Wilson Tariff Act of 1913, putting cyanide on the free list, the output of our cyanide factory at Perth Amboy, N. J., was not equal to the growing needs of this country; thus it was necessary to import cyanide to meet the increasing requirements of the United States.

At the outbreak of the present unexpected European war, we immediately proceeded to rehabilitate our factory at Perth Amboy, by obtaining additional and sufficient supplies of raw materials so as to operate our works on a much larger scale than heretofore, and thus meet the extraordinary conditions. In addition to this, arrangements have now been made to procure a 1,000-ton shipment of cyanide from Germany, which is to come forward on an American ship, and this will also relieve the situation in Mexico, as all the cyanide we intend to import is to provide for Mexican consumption.

Mr. Aldridge.—What protective tariff would be necessary to manufacture cyanide here?

Mr. Ruhl.—If, in common with all other countries, the United States were on a free-trade basis, no protection would be necessary; but with a protective tariff on some things and cyanide on the free list, we are handicapped in the cost of production by reason of the higher cost of raw material, labor, land, equipment, and capital investment compared with European conditions.

The total annual consumption of cyanide in the United States is about 2,000 tons, and in Mexico 5,000 tons. With the enlargement of our Perth Amboy plant, which is now almost ready to begin operation, we shall be able to supply the whole consumption of the United States; but must continue to rely on importations to supply the Mexican demand. Under the Dingley tariff of 12½% *ad valorem,* an amount of protection with which we were quite satisfied, we were able at all times to supply the whole American demand. The raw materials we consume are sodium, ammonia, and carbon.

The Sampling of Low-Grade Ore Deposits.

S. J. Jennings.—The next subject for this evening is the sampling of low-grade ore deposits, at which I have had considerable experience, as has also Mr. Mein. We have recently had an interesting problem in Alaska. The ore was supposed to carry

$2 in gold, from which a profit of 75c. per ton was expected. An error of 25c. per ton in sampling might cut 33 1/3% from our profits. The question was, were we taking specimens or samples? We were cutting channels 6 in. wide by 2 to 3 in. deep, 5 ft. apart in the crosscuts; and while one might suppose that if there were enough crosscuts the law of averages would hold, and errors would balance themselves, we found that successive 5-ft. samples would assay from trace to $12 or even higher per ton; hence, it seemed unwise to depend on averages, when the total number of samples would necessarily be small.

We took samples over a strip 2½ ft. wide along the crosscuts for the full height, getting 30-ton samples for each 12-ft. crosscut. These we ran through a 5-stamp mill. At first 30-mesh screens were used, but finally a slotted screen equivalent to 60 mesh. The pulp from the stamp was run into a 12-in. launder and the stream was cut at periodic intervals, taking out 1¾% as a sample. This sample was amalgamated, and the tailings from the amalgamating barrel were sampled, which could be done with accuracy to within 4c. per ton.

Yet we were never satisfied that the gold recovered in the amalgamating barrel was the right proportion of that in the original ore. Suppose you took 32 samples of ¾ lb. each from the same ore, crushed to 40 mesh. If you crushed each sample to 100 mesh and split it, the halves would vary by, say, 4c. But if you took another of the original 32 samples, the variance between it and the first might be from $1.50 upwards, showing that even with 40-mesh material individual pieces of gold would go through the quartering process and not be proportionately distributed. Our millman finally put in a Wilfley table to concentrate the original 30 tons. We concentrated out about 1½% of the original, which carried all the free gold, the pyrite, galena, etc. The tailings from this table could be sampled accurately. The concentrates were amalgamated in a barrel, the tailings from which could also be sampled. In order to ascertain the value of the original sample of 30 tons we had the following factors: Net dry weight of ore crushed; weight of concentrates recovered; total amount of gold recovered in the amalgamating barrel; assay of the tailings from the barrel; assay from the tailings from the Wilfley table; total amount of gold remaining in the sand around the dies in the battery. This plan has been working three to four months and we really have secured results that check. I don't know Mr. Mein's method, but he will now tell us about it.

Mr. Mein.—Our sampling method at the Dome mine is based on the theory that a large number of samples is better than

a few large ones. The system involves the cutting of a groove about 4 x ¾ in. with moil and 4-lb. hammer, which gives 3 to 4 lb. of ore per foot of groove. In drifts these grooves are spaced 5 ft. apart, but in crosscuts the grooves are continuous and are taken on both sides.

The rock faces are washed before sampling, and the different characters of rock encountered are sampled separately in order to learn in what rocks the gold occurs. Originally, the section to be channelled when in rock of the same character was limited to 2 ft. but with increased knowledge larger sections were taken.

All sections were carefully measured from survey stations, and distances were noted to facilitate re-sampling and for mapping results. The measure of the sampler's efficiency was not the number of samples he took, but the care with which he took them and kept his notes. The work of sampling was done by technical graduates assisted by laborers; their work keeps the mine foreman informed and at the same time relieves them of much labor, thus conducing to higher efficiency.

At Dome upwards of 12,000 ft. of development has been done and over 15,000 samples taken. The sampling system at Dome has given reliable results.

When calculating ore reserves, high or low values are not rejected unless the doubtful places are re-sampled and found to give different results. Rejecting the high samples would not be fair to the Dome deposit unless re-sampling gave different results.

In case of a carefully conducted mill test, I believe the gold produced, plus loss in tailings, by crushing all the rock obtained, say, from a 1,000-ft. tunnel would be found to agree with the values determined by groove or channel sampling, if intelligently done, and if the sections were taken at reasonably short lengths along the side of the same tunnel. The accuracy of a mill test on a large scale is indisputable, but the test requires considerable time and, when completed, does not give the same detailed information as groove sampling.

Mr. Catlin (*addressing Mr. Jennings*).—How fine are your samples? You spoke of 100-mesh; is that fine enough? I have seen ores that would not check at 100-mesh, but did so at 200-mesh. Do your 100-mesh samples agree?

Mr. Jennings.—When crushed to 100-mesh, from 55 to 60% of our ores pass 200-mesh.

Mr. Catlin.—The checking, however, depends on how the gold occurs. For instance, at Gold Bluff, Cal., the gold is very thin; at other places granular.

Mr. Tillson *(addressing Mr. Mein)*.—What was the technique of your sampling? Was a reference plane taken, and the bulk of the sample calculated constantly to that, or did the sampler exercise his own discretion?

Mr. Mein.—All crosscuts and drifts were sampled. The sum of the sections in a crosscut, since they are taken along it, must give its length, and the position of each section was determined in reference to the survey points.

Mr. Tillson.—But in drifts, part of the sample is taken in the roof, part on the floor, part on the walls. Are any calculations made as to the varying volumes given by cuts of equal width on the various sides of the rectangle, or any allowance made for varying angles of intersection of the sample cuts with the strata?

Mr. Mein.—No. It would hardly be possible, owing to the variable schistosity.

Mr. A. H. Rogers.—It comes down finally to a question of multiplicity of samples.

Mr. Mein.—Yes. The Dome is a massive deposit and it is not necessary to make allowances for varying angles of intersection of the sample cuts with the strata. It is due to the multiplicity of samples that reliable results are obtained.

[Discussion here ensued between Mr. Spilsbury and Mr. Mein as to whether these samples gave sufficient geological knowledge to allow sorting; after which the discussion reverted back to Mr. Jennings' remarks on sampling in Alaska.]

Mr. Wilkens.—Did you run all your 30-ton sample over the table? Could it have been stamped and run over amalgamating plates?

Mr. Jennings.—No. By running it over plates, too great a proportion is absorbed. This was not a mill run, but a sampling. The table was only a convenient method of getting the gold into a small bulk that could be sampled.

Mr. Tillson.—In our sampling at Franklin Furnace, a question arose as to influence of volume of sample taken to volume represented, and the direction of the sample cuts. It was found that the commonly accepted prismoidal formula does not hold in the volumetric measurement of mine drifts and other irregular openings, for the middle section of any prismoid receives four times greater consideration in the calculations than either of the end sections; and, since it is rarely possible to connect corresponding points

of three sections by straight lines, as in true prismoids, the difference between surveyed area of the middle section and the area of the middle section of a true prismoid having the ascertained end sections is multiplied four times, since the prismoidal volume $=(A_1+4A_2+A_3)\times L\div 6$. Volumes based on the geometric average of end areas, as deduced by Mr. A. M. Johnson, proved more accurate in our mine tests, and were expressed by the following formula:

$$V=(A_1+A_2+\sqrt{A_1\times A_2})\times L\div 3.$$

After a little desultory discussion of this point, the meeting adjourned at 10 p. m.

D. M. Liddell,
Secretary of Section.

COMMUNICATIONS

J. Parke Channing.—I find great variation in the various mining and metallurgical companies in the methods of keeping cost accounts, such for example as blast-furnace expense, reverberatory expense, converting expense, or concentrator expense. I would suggest that a study of this question and a report as to universal methods would be a desirable subject for the Society to undertake.

Take, for example, the subject of converting. Some companies charge the cost of treating converter slag to converting and make it as a credit to either the blast furnace or the reverberatory furnace. Other people consider that it has a fluxing value and do not make any charge to converting.

At some copper mines the cost of coarse crushing is charged to the mine, and in other cases it is charged to the mill, so that comparisons of published figures are fallacious. Even where private exchange of information is made between companies themselves, it becomes necessary in each case to ask what are charged to the particular operatinng expenses.

J. A. Burgess.—I have kept your letter of July 1, in which you asked for suggestions for discussion by the Society, on my desk since receiving it in hopes that a subject worthy of discussion by the Society would suggest itself. I think that the broadest subject that will interest the mining industry in the West at the present time is that of compulsory industrial insurance or workmen's compensation laws, and I would offer this as a subject for discussion.

The Nevada Industrial Insurance Act, which was passed

March 15, 1913, and has been in force since that time, has worked out in a very satisfactory way, as concerns the mine operator, and I think that, in a great many cases, the injured miners or their dependents, who have come under the operation of the law, are satisfied with it. On the other hand, the Unions, their officials, and the Socialists have a great deal of fault to find with it. For this reason, it is generally understood that the law will be brought up for revision in the legislature that will meet during the present year. Among the things that will be proposed by them I believe will be the following: (1) An increase in the amount of compensation, and (2) compensation to be paid in all cases from the time of the accident instead of beginning ten days after the accident. The principal benefit of this Act to the employers is that it frees them from danger of law suits and jury verdicts for excessive damages. The principal benefit of it to the injured workmen is that it gives them prompt financial relief during their disability, and where awards are made for permanent injuries the partial compensation is prompt and certain, and is made without the intervention of a lawyer.

If you see fit to bring this subject up for discussion, it is possible that a copy of the Act may be of use to you and I enclose one herewith.

PERSONAL

Benjamin Magnus, general manager of the Mt. Morgan Gold Mining Co., spent the summer of 1914 in New Guinea, inspecting mines of low-grade basic copper ore recently acquired by his company, and designing installation of trams and wharves.

Ralph S. Rainsford was married to Marguerite S. Le Breton on Nov. 9.

Alexander P. Rogers has gone to Peru, where he expects to be occupied with professional work during the next eight or nine months.

MEMBERS ELECTED IN NOVEMBER, 1914

Argall, George O.....Leadville, Colo.
Manager Iron Silver Mining Co.

Rigg, Gilbert .....Palmerton, Pa.
Head of Research Dept., N. J. Zinc Co.

Mining and Metallurgical Society *of* America

Vol. VII December 31, 1914 No. 12

ANNOUNCEMENTS.

Annual Meeting.—The sixth annual meeting of the Society will be held at the Engineers' Club, 32 West 40th St., New York, on Tuesday, Jan. 12, 1915. The first session will be at 2 p.m. and the second at 8:30 p.m. The annual dinner of the Society will be held in the Engineers' Club at 6:30 p.m. This will be informal.

Members who are intending to be present at the annual dinner are requested to promptly notify W. R. Ingalls, 10th Ave. and 36th Street, New York. *It is important that this notification be communicated promptly in order that the necessary arrangements for the dinner may be made.*

New York Section.—A meeting of the New York section was held at Browne's Chop House on December 17, thirty-one members and guests being present. A full account of this meeting will be published in the next bulletin. The January meeting of the New York Section will coincide with the annual meeting of the Society.

Samuel Franklin Emmons Memorial Fellowship.—The friends of the late Dr. Samuel Franklin Emmons have established a fund, whose income may be used in support of a fellowship to promote investigations in the branches of geology which were cultivated by him, more especially on the economic side. The funds have been placed in charge of the Trustees of Columbia University, but the choice of the fellow and the expenditure of the income are intrusted to a committee consisting of Professors James F. Kemp, John D. Irving and Waldemar Lindgren. The committee announces that it will be prepared to award in March, 1915, a fellowship of $1,000 for the year July 1, 1915, to June 30, 1916, inclusive. Applications must be made on blanks which will be furnished by the Secretary of Columbia University, New York, N. Y., and which, when filled and accompanied by testimonials and complete statements of the applicant's qualifications, will be submitted by him to the committee on

Mar. 1, 1915. Applications must be received by the Secretary of Columbia University before this date.

The committee requires that applicants should be qualified by proper geological training and experience to undertake the investigation of some problem in or related to economic geology. Each candidate is expected to submit with his application a definite statement of the problem which he proposes to study. The carrying out of the investigation will be under the oversight of the committee and may be undertaken at any place or institution which may be preferred by the holder of the fellowship and which will meet the approval of the committee. The place and publication of results will be decided by the committee. The committee will require that the holder of the fellowship agree to give his entire time and energies to the problem selected, and further agree to contract no other engagements conflicting with or restricting this work without its consent. No objection will be made to the use of the results as a dissertation for the degree of Ph.D. in an approved university.

W. R. INGALLS,
Secretary.

COUNCIL MEETING

A meeting of the council was held at the Engineers' Club, New York, on Friday, Dec. 11, at 5 p.m. The members present were Messrs. Channing, Finlay, Ingalls, Kemp, Spilsbury and Stone, a total of six, this constituting a quorum.

The Secretary reported that the ballots for nominations of officers were canvassed by him on Nov. 4, in conformity with the requirements of the by-laws, and that the final ballot, embodying the result of the vote on nominations, had been issued to the membership on Nov. 13, 60 days in advance of the forthcoming annual meeting in conformity with the by-laws. [The ballot was published in bulletin No. 78, page 156.]

The Secretary read the following communication from Mr. Hennen Jennings:

> I suggest that the council pass a resolution of sympathy with the family of Professor Christy, who died on Nov. 30, and express appreciation of his work.
>
> I have known Professor Christy for over 35 years and have ever had a great respect and regard for him. He has worked nobly for our profession in that he has stood for honesty, thoroughness and advancement in the training of his young men, and has benefited his University as well as his students.

Upon motion, duly seconded, and unanimously carried, the President was authorized to express to the family of the late

Professor Christy the condolence of the Society and its appreciation of his valuable work.

There was some discussion of plans for the forthcoming annual meeting of the Society, and it was decided to hold the meeting as usual in the Engineers' Club, with a business session in the afternoon and a dinner and social session in the evening, the Secretary to make the necessary arrangements.

The President read the following report of the Committee on Annual Medal:

In accordance with the requirements of the rules and regulations, article C. paragraph 4, your committee begs to report the following two names as candidates for the medal:

ROBERT HALLOWELL RICHARDS
ALEXANDER STANLEY ELMORE

The vote so far as received by us, was almost unanimous in favor of Dr. Richards.

The award to Dr. Richards would be based on the wonderful services he has rendered to the mining industry in general and particularly in the field of ore dressing, his work on the latter branch being considered as monumental.

Mr. Alexander Stanley Elmore's name is presented as having made the greatest advance in the art of ore-dressing by his inventions in its inception of the flotation methods of concentration.

Respectfully submitted,
E. GYBBON SPILSBURY, *Chairman*,
JAMES F. KEMP,
ARTHUR L. WALKER.

By order of the President, the names of Robert Hallowell Richards and Alexander Stanley Elmore were submitted to the members of the council for letter-ballot, in accordance with the rules and regulations.

The President read the following communications from H. V. Winchell, chairman of the Committee on Mining Law, and M. L. Requa, a member of that committee:

As chairman of the Society's Committee on Mining Law and after full conference with Mr. C. W. Goodale, also a member of that committee, I desire to bring to your attention, and that of the Society, a matter which seems to me of interest at the present time.

The subject of mining law revision has already engaged the attention of our members and of mining men generally. The Society voted upon certain recommendations of its Committee on Mining Law, and communications were addressed to members of Congress, advocating a certain program in connection therewith. The bills were introduced into Congress, providing for revision of certain particular portions of the mineral land law and also providing for the appointment of a commission to consider the subject and make recommendations. Some of these bills had the endorsement of the administration and were looked upon as administrative measures. One of these bills, viz., the Alaskan coal land measure, passed both Houses of Congress. Others, such as the Omnibus Leasing Bill for non-metallic deposits and the Commission Bill, passed but one House and are unfinished

business for the second session of the present Congress. That there will be a revision of some sort seems to be assured, but that this revision will be in accord with the sentiments already expressed by the Society is doubtful.

It is well known to most of our members, who are also members of the American Institute of Mining Engineers, that the latter society is prohibited by its constitution from making recommendations as an organization of mining men, and that it can not at the present time go before Congress, the Secretary of the Interior, or the President of the United States and urge the necessity for certain reforms. There are no such limitations upon the Mining and Metallurgical Society. It is quite in accord with the general principles and aims of the Society to take up public matters of this sort which have to do with the welfare of the mining industry. It has been a matter for comment that the Institute of Mining Engineers has been quite largely adopting the methods and policies of our Society and that the opportunities of the latter have been diminished. It has even been suggested that there might soon be no longer any field for its endeavors.

To myself and fellow-members of the Committee on Mining Law (although in this particular instance I speak without conference with Mr. Requa, yet I have no doubt I am voicing his sentiments, too) the present seems to afford a particularly timely and important opportunity for the Mining and Metallurgical Society to undertake to represent the mining industry in furthering its demand for mining law revision. With our membership of leading and prominent and influential men we can, by co-operation and earnest work, bring to bear upon the Administration sufficient influence to procure the desired end. With the authority and backing of the Society we can make such a presentation of the case to President Wilson and Secretary Lane that they cannot refuse to make it a part of the administration program. They are "constantly pointing with pride" to the constructive legislation already passed under Democratic control, and I think they will see an opportunity to sharpen their pointer and point it with more pride in the passage of legislation which shall do away with our present archaic and loose-fitting mining laws.

I should, therefore, like to present, as a recommendation from the majority of your Committee, the adoption immediately of an active program in this direction. The Society is already entitled to much credit for the leading part which it has taken in the agitation for mining law amendment. It can easily under the present circumstances take such further action as to entitle it to the lion's share of credit for actual achievement.

H. V. WINCHELL, *Chairman.*

The following, from Mr. M. L. Requa:

Mr. Horace V. Winchell has forwarded me a copy of his letter of Nov. 13 to you.

I believe that his suggestion that the Mining and Metallurgical Society consider the question of mining law revision, is a good one, and would suggest that the Society take up the matter, and, if found possible, urge the passage of any bills that seem to be in accord with the views of the Society.

M. L. REQUA.

Upon motion, duly seconded and unanimously carried, it was resolved that the council should urge upon the Administration at Washington the views of the Society respecting revision of the mining law, as expressed in its formal action on Mar. 30, 1914,

and that the President be empowered to arrange the mode of making such representation.

The President read the following report of Mr. B. B. Lawrence, chairman of the Committee on Professional Ethics:

In a communication which I addressed to the Secretary last year, and in a letter to the former President of the Society, Mr. Chance, I took the position that this Society needed no code of ethics.

The members of the Society have been carefully selected; are men of mature minds, and of experience in their profession. To my mind they need no code of ethics beyond that accepted by all professional and business men of high standing. It would be unwise even to suggest that members of this Society need such a code to regulate their conduct in their transactions with their fellowmen.

At best, a code of ethics is but an attempt to put into words the moral code covering this relationship. I believe it would be an insult to the members of the Society to suggest to them, what must be fundamental in their behavior as professional men. If they were college students, or young men beginning a career, it might be well to attempt to inculcate those principles for which all engineers should stand.

I have done my best to explain before in various communications that I see no reason for the existence of this committee, and I hereby tender my resignation as its chairman.

B. B. LAWRENCE.

Upon motion, duly seconded and unanimously carried, the report of Mr. Lawrence was accepted, and ordered placed on file, and it was voted that the Committee on Professional Ethics be discontinued.

The President read communications from Messrs. C. R. Corning and Robert Peele, members of the Committee on Standardization. Upon motion, duly seconded and unanimously carried, the adjustment of affairs with respect to this committee was postponed.

W. R. INGALLS,
Secretary.

MINUTES OF MEETINGS.

NEW YORK.

The November meeting of the New York section was held at Browne's Chop House, on Thursday, Nov. 19, at 8 p.m., Sidney J. Jennings, presiding. The following members and guests were present: W. H. Aldridge, E. S. Berry, D. H. Browne, R. M. Catlin, J. Parke Channing, H. M. Chance, C. D. Clark, Ronald Clark, R. W. Deacon, J. V. N. Dorr, E. L. Dufourcq, H. W. Du Bois, Mr. Cunningham, A. S. Dwight, Sydney H. Ball, J. R. Finlay, C. R. Corning, H. W. Hardinge, Kuno Heberlein, W. R. Ingalls, L. D. Huntoon, Hennen Jennings, Sidney J. Jennings, H. L. Hollis, J. B. Farish, J. F. Kemp, W. McA. Johnson, J.

V. Lewis, D. M. Liddell, W. W. Mein, George Moore, O. B. Perry, W. A. Pomeroy, W. A. Prichard, E. M. Rogers, A. H. Rogers, Bradley Stoughton, Otto Sussman, Robert Sticht, F. F. Sharpless, T. T. Read, D. M. Riordan, E. G. Spilsbury, Franklin Guiterman, G. D. van Arsdale and E. A. C. Smith.

The Chairman.—We shall have the pleasure of listening this evening to Prof. J. F. Kemp, who will speak on "The Newer Theories of Ore Deposition."

The Newer Theories of Ore Deposition.

J. F. Kemp.—When the International Geological Congress assembled in Berlin in 1885 it was raining as furiously as it is outside to-night. The Minister of the Interior welcomed the delegates with these words: "To members of your calling, in which water plays so large a part, I need make no apologies for the weather." It is the universal experience that we can not discuss the deposition of ores without calling upon water as the chief agent in the process. Last February, when the medal of the Society was presented to Mr. and Mrs. Hoover, Mr. Hoover, in his very interesting speech of acceptance, reminded us that Agricola had also written another work entitled "De Ortu et Causis Subterraneorum," and he said, with a significant glance at the present speaker, that if some of our modern students of the subject could read this work they would find themselves forestalled by Agricola nearly 400 years ago. We learn that Agricola believed the veins to be formed by what he called the juice of the earth. He did not specify its particular source, but his views were evidently not very far from those held by many to-day. One of our own phrases is, the juice of the magma.

Whenever we discuss the formation of veins, the idea of solutions of some sort is necessary. In the early 50's the distinguished French geologist Elie de Beaumont prepared a paper upon the connection between ore deposits and volcanic phenomena. He concluded that emissions from igneous rocks were not without their decided importance, but his views attracted little attention and were largely overlooked in the discussion of the next 50 years. The general attitude of those who thought about the subject was somewhat as follows, which we may formulate even though we would find it difficult to point to their exact expression in any particular work. Rains were observed to fall upon the surface of the earth. The rain water was believed to percolate downward through cavities in the rocks, and to furnish the ground-water. In certain wet mines the amount of ground-water was highly impressive. Observers therefore concluded that

it continued in its downward passage through the rocks to relatively great depths. During its descending it wandered extensively and took into solution the minerals of our ores and gangue from the rocks with which it came in contact. Encountering, perhaps, a large waterway, such as might be furnished by a fault line leading to the surface, the solutions mounted upward. Coming from regions of heat and pressure, they passed gradually to those of lower temperatures and diminishing pressures; the dissolved minerals were precipitated, the veins were filled, and hot springs emerged at the surface. These views were to some extent committed to paper; they were also expounded in the lecture room by "Uncle Joe" Le Conte in the University of California, and "Uncle John" Newberry in New York. They also found more or less definite expression in the writings of Mr. S. F. Emmons and others not engaged in teaching. Whether or not masses of intrusive rock as storehouses of heat assisted in stimulating circulations is not always definitely stated, but probably they were regarded with respect by some, although Dr. Newberry was always rather strenuously opposed to their influence in the production of ores.

We come now to the meeting of the American Institute of Mining Engineers, which was held in Chicago in connection with the World's Fair, in 1893. Every endeavor had been made to present a program of unusual importance. The great paper of the meeting was that from Franz Posepny upon "The Genesis of Ore Deposits." The essay was one of exceptional value, and embraced the results of observation and reflection extending over a life-time. Posepny established two zones. The upper one, between the surface of the earth and the standing ground-water, he called the vadose, or shallow zone. In it the operations of the descending rain waters were of an oxidizing nature, and were extremely vigorous. From the level of the ground-water to an indefinite depth extended the deep-water zone. The movements of the deep waters were slow. The extent to which they penetrated into the earth is not definitely stated, but great attention was given to uprising springs in mines. There is little doubt that the deep waters were regarded by Posepny as originating in the rainfall. The fact that no definite statements were made regarding the depth to which they continued left an important opening for further contributions. Posepny's paper, as we all know, led to an animated discussion, practically all of which ran in favor of the views which he had advanced.

In 1900, interest in the subject was again aroused by the presentation to the American Institute of Mining Engineers of another paper by Prof. C. R. Van Hise, entitled "Some Princi-

ples Governing the Deposition of Ores." The subject of cavities in rocks received careful attention. The depth to which cavities can maintain themselves beneath the ever-accumulating load of superincumbent rock had been calculated by a colleague, Professor Hoskins. It was placed at somewhere about 10,000 m. Water, practically all from the rainfall, was believed to extend down to the limit of cavities; to pass through extended masses of rock, wandering more or less laterally; and after taking into solution the minerals of ores and gangue, and after absorbing much heat because of the normal increase of temperature with depth, to rise again to the upper world, depositing the vein filling in its passage. Three zones were established; a zone or belt of weathering or solution, corresponding to the vadose zone of Posepny; a zone of enrichment on or near the water level and a zone of cementation or precipitation at great depth. These views were verified by many examples and were presented in a way that carried almost universal conviction. We may say that they marked the high tide of the views dependent upon rain waters, often called the meteoric waters, as agents in the production of veins. From them we may now turn to the development of others of a contrasted nature, and then to certain limitations to which the views dependent upon the rain waters are subject.

Early in the 90's, readers of the literature on this subject began to be impressed with the valuable contributions from Prof. J. H. L. Vogt, of Christiania, Norway. In the first volume of the *Zeitschrift für Praktische Geologie,* Professor Vogt published a series of papers embracing views which he had gradually developed by years of study in Norway. They relate partly to the basic masses which we find in igneous rocks, such as the titaniferous iron ores, which are direct crystallizations from a molten magma; partly to the border effects of igneous masses, effects which were believed to be due to emissions from the igneous rock. In the latter group come the pegmatites with their contents of rare earths; the tin ores associated with quartz, feldspar and mica; and apatite deposits in close connection with intrusive masses of gabbro. These deposits Professor Vogt called "pneumatolitic" when produced solely by gases or vapors; and "hydato-pneumatolitic" when produced by vapors in connection with liquid water.

The two words are rather formidable; they hardly give you an idea of the great charm which Professor Vogt possesses. I cannot forbear relating an incident which casts some light upon him as a man and a friend. On one of the short excursions connected with the International Geological Congress, held in Stockholm in 1910, we were walking together along a railroad track

between outcrops. I was anxious to know something of Professor Vogt's relation with his students, and I asked him a few questions as to whether he knew the young men intimately. "Oh yes," he said, "they come to me for all sorts of advice, to borrow money when they are in difficulties, to ask whether they ought to get married or not, and for counsel in many of their personal affairs." "You know," he added, "there are two kinds of professors, the one kind are 'uncles,' the other kind are 'privy councillors.'" You will now understand why I spoke of "Uncle Joe" Le Conte and "Uncle John" Newberry, a few moments ago.

The first papers of Professor Vogt have been followed by a long series since them. The ideas suggested were also germinating in the minds of others on this side of the water. We find in the monographs of J. E. Spurr, on Aspen and on Mercur, the conclusions that the ores were derived from some deep-seated mass of igneous rock. During these years in the decade of the 90's, we all began to think there must be something in the waters which might be derived from crystallizing bodies of molten and cooling masses. Some of us were also wondering whether the meteoric waters quite met all the requirements of the case.

At the meeting of the American Institute of Mining Engineers, held in Richmond in 1901, I made the point that the deep mines, which were rapidly multiplying in various places the world over, passed through a zone of water-bearing rocks, and if the water were impounded in the upper levels, their lower workings were practically or actually dry. There were indeed one or two regions of expiring igneous activity, such as the Comstock Lode, in which bodies of water were met at great depth. But we may set these aside because the waters are open to the charge of being magmatic. The universal experience elsewhere proved waters to be limited to the upper 1,000 or 2,000 ft. of the crust. Of course, if our experience gained in mines is a fair indication of the distribution of meteoric waters in the earth, then the old views become untenable. We might infer that a suddenly developed fault would tap them downward along its course, but if we try to imagine our veins to be filled by waters which passed downward in the restricted area of a fault, become to a limited degree influenced by interior heat, and rose again, to the surface with very limited lateral wanderings, we are confronted with great difficulties in accounting for the filling of our veins. The metals are very sparsely distributed in the rock. Waters could gather up the amount which we find in our veins only by extensive wanderings; the limited circulation in and around a fault would be insufficient. The same view of the distribution of ground-waters was shortly after adopted by T. A. Rickard and by John W. Finch, in important contributions.

From another source the idea of magmatic waters received strong support in 1902. At the famous health resort of Carlsbad, Bohemia, was held a congress of physicians and scientific men. At the invitation of the congress, an address was delivered by the venerable Austrian geologist, Edouard Suess, on the Carlsbad hot springs. Professor Suess, as a very young man, had made one of his first contributions to science, many years before, in a paper on these springs and had considered them during all the years of his subsequent life. He made the point that they were in no respect sympathetic with the rainfall; they poured out the same amount in times of flood and of drought, as testified by the records of a thousand years. The spring waters are strongly charged with lime, and yet they come to the surface through granite, a rock extremely low in lime. He therefore insisted that they could not conceivably originate in the rainfall, but that they were deep-seated waters, probably coming from some such mass of igneous rock as a basalt. Since they there reached the upper world for the first time and were young, so to speak, he called them "juvenile" waters. Since then, the name "juvenile" has been used as a synonym of "magmatic," although from the different sense in which "juvenile" is used in English, the term "magmatic" is generally preferred in this country.

Another support for belief in magmatic waters is found in the phenomena of volcanoes. For many years geologists have observed that clouds of steam, or at least, of a vapor believed to be steam, were poured forth from active vents. The conclusion was generally reached that the expanding and even explosive steam had much to do with the bringing of lava to the surface. Geologists had also observed that volcanoes were chiefly situated near the sea coast, or upon marine islands. A view was often expressed that the sea water, percolating through the rocks, migrated toward and into the hot molten magmas and thus furnished the steam which finally emerged from the vent. An experiment of Daubrée was cited in support, which showed that water could be drawn by capillary attraction through an inch or two of porous sandstone into an underlying and tightly enclosed chamber in which was a pressure of one or two atmospheres. Reflection brought out the important point, however, that it was a very different thing for water to emerge into an open cavity at moderate temperature and comparative low pressure, and for the same water to migrate through a great thickness of rock of which the temperature gradually increased up to 2000° or 3000° F. The course of the water would be away from the highly heated mass of igneous rock as soon as it came within the influence of its heat. We have therefore concluded, in the last 10 years, that the steam rising from volcanoes is derived from gases

of deep-seated origin, dissolved in the molten rock itself, and brough by it to the upper world.

About 1910 a Swiss chemist, named Paul Brun, residing in Geneva, published some views antagonizing the existence of water in volcanic rock. Mr. Brun had begun by determining in a careful way the fusion temperatures of feldspars and other rock-making minerals. In this way his name first became known to geologists at a distance. He then devoted himself to visiting volcanoes, taking samples of their emitted gases and analyzing them, especially for the determination of water. As the result of his analyses, he came to the conclusion that neither steam nor water was emitted by them. He believed that the cloud which we so often see hanging over a volcano was finely divided ammonium chloride, and in a paper delivered before the Congress of Mining, Metallurgy and Geology, at Düsseldorf, in June, 1910, he contested the idea of water in volcanoes at all. Subsequently, in a large monograph on volcanic emissions he finally stated that water could no longer be regarded as a factor in volcanic action. These views created great surprise, and while they staggered those of us who had pinned our faith to the presence of water in volcano rock, they did not convince us. The old-time views seemed so thoroughly grounded that we awaited confirmation of Mr. Brun's results.

In 1912, Dr. A. P. Day and his associate Dr. E. S. Shepherd, of the Carnegie Geophysical Laboratory, in Washington, spent some months at the lake of fire in the crater Kilauea of the Hawaiian Islands. Mr. Brun had also visited this volcano and had based some of his most sweeping statements upon the results of his experiments there. By a lucky coincidence, during the stay of Messrs. Day and Shepherd a dome of solidified lava developed on the solid flat a short distance from the great pool of molten rock It was possible to approach this dome within which the molten lava was boiling and emitting gases. A short iron tube was pushed through a crevice and was connected with a series of hard-glass tubes, terminating in 20 condensing glass reservoirs, each holding about half a liter. At the far end was a pump by which the gases were at once pumped through these series of pipes and condensers so as to furnish samples for analysis. The pumping was continued for some time in order to drive out the air already in the tubes, but scarcely had the pump been set in operation before water began to condense in the tubes and the reservoir. In the end, as much as 100 c.c. were condensed in a tube having a total volume of 500 c.c.

When the Geological Society of America met in New Haven during the Christmas holidays of 1912, Dr. Day addressed the geologists present. He told of his trip to the Hawaiian Islands

and reviewed very carefully, and at length, the experiments and conclusions of Mr. Brun. The audience could not tell, during all his preliminary remarks, what results he had to announce. When, however, he had worked us up to a suitable climax, and produced from behind the desk one of his tubes with 100 c.c. of volcanic water in it, visible to us all, I know that, for one, a great load was lifted from my mind. Since these experiments we have had no doubt about the existence of copious amounts of magmatic waters, and we can not but believe that the deep-seated magmas are often richly provided with them. They are doubtless more abundant in the magmas high in silica but they do not fail in the basic ones. If such a mass of molten rock well provided with gases and fairly deep below the surface is forced into the midst of other rocks; and if it slowly cools and crystallizes to anhydrous silicates, the contained water must be evicted. We have thought that the gases and associated water pass upward and outward, perhaps through an already cooled and cracked shell of the igneous rock, and that then they play an important part in the circulation of the ground-waters.

From another significant quarter the evidence has been accumulating. All mining engineers of extended experience in the field know how often ore deposits are found at the contact of igneous rocks with rocks of a sedimentary nature, and especially with limestones. In the Southwest and Mexico contact deposits are innumerable. The old-time view regarding their formation was that the contact zones were produced from impure beds in the limestone, by the influence of igneous rock. If, for instance, in addition to the carbonates of lime and magnesia, a bed contained silica, alumina, and some iron oxide, the silica, under the influence of heat, would combine with alumina and with lime or magnesia and such iron as was present, to produce lime silicates and lime-alumina silicates. We came to use a definite name for this group of minerals and called them "the lime silicates." The principal ones were garnet, diopside, epidote, vesuvianite, wollastonite, and a few rarer ones. The garnet was believed to be the variety grossularite, a lime-alumina garnet. Now alumina is a common ingredient of limestones, and especially of the hydraulic varieties, or cement rocks. No great improbability was involved in believing that the grossularite represented a crystallized, aluminous, siliceous limestone, because we know of many such occurrences away from the contact zones.

In 1905, however, Professor Lindgren, working upon the zones at Morenci, Ariz., and I, describing others at San Jose, in Tamaulipas, Mexico, simultaneously announced that the greater part of the garnets were lime-iron garnets, of the variety and radite. Now it is one thing to derive a lime-iron silicate from an or-

dinary limestone, and another thing to derive a lime-alumina silicate. Limestones contain very little iron, but the contact zones contain a great deal. They habitually display, besides the silicates, large bodies of magnetite and sometimes of specular hematite. We thus still found great difficulty in believing that such rich iron-bearing zones produced by the recrystallization of limestone. We both, therefore, urged that emissions from the igneous rock in the form of steam or its dissociated gases, and of silica, probably in the form of orthosilicic acid, and of iron salts, probably iron chlorides, had been fed into the limestones and had produced the zones. These views were quite revolutionary with regard to the zones, as anyone can learn by reading the earlier literature. No one has ever been able satisfactorily to explain the iron-bearing minerals in any other way. The evidence of the zones is therefore a strong additional argument in favor of magmatic emissions.

There is still another far-reaching argument in favor of this form of water. If, in accord with the older conception, we imagine the rain water sinking into the rocks and going only to moderate depths, as we are obliged to do, in conformity with our underground observations; and if we imagine it again rising to the surface this comparatively short journey, during which we require it to dissolve the irregular and sparsely distributed metalliferous components of the rocks and again to precipitate them in our views in its upward journey, we require it to perform two contradictory reactions under the same physical conditions. We can hardly believe that under one set of conditions solution would take place, and in another without essential contrasts, precipitation would result. But, on the contrary, if we imagine highly heated and even vaporized emissions to come from the interior of a great igneous mass and to be charged with our ores and gangue, we see that they must very soon be subjected to a marked change in conditions and we may reasonably infer precipitation.

The recent studies of Edwin T. Hodge, which have been based upon the mine waters of sulphide bodies, show that when the rain water starts to percolate downward it becomes, in the gossan, an acid solution of iron, zinc, and copper. As it passes lower through the rocks, especially in the wall rocks of a mine already open, so as to make circulation possible, it gradually becomes neutral; the copper and zinc are quickly precipitated, but iron remains to a somewhat greater but still only to comparatively shallow depths. Before long, the iron also is precipitated and the water becomes alkaline, with no metals at all in solution, other than alkalies and alkaline earths. A strong argument is

therefore made against the efficiency of descending rain waters and against their ability to produce the veins with which we are familiar.

Somewhat of a compromise view has lately been strongly advocated by Professor Lawson, of the University of California. Professor Lawson is well aware of the almost universal association of ore deposits in the Western country with igneous rocks. He believes that the igneous rocks have often entered a synclinal basin as laccoliths, and have extensively cracked the overlying strata, but have remained in the depths, with the strata on both sides dipping from heights of land downward and forward toward them. After the laccolithic mass has cooled enough to permit the circulation of meteoric ground-waters through it, he believes that the waters pass downward by an artesian flow through porous beds at the sides, into and through the igneous rock, dissolve from it the metals and the gangue, and are driven out through cracks in the overlying sediments by the shorter route to the surface. He cites several cases in which veins are associated with intrusive masses, where he believes the structure to have been synclinal. There is nothing impossible in this view, and it offers a reasonable method by which meteoric waters might accomplish the work. The chief objection is that the intrusive entrance of a mass of igneous rock under ordinary conditions of synclinal structure would tend to elevate the rock above it to a greater altitude than the strata on either side. The flow, we might infer, would be vertically downward into the igneous mass, and outward and upward around its borders, if any flow were to develop; whereas the cracks in which veins might be deposited would seem more likely to be over the laccolite than outside its influence.

In conclusion, we may perhaps carry in our minds the significance of the various arguments advanced, and understand why it is that so many students of ore deposits have come to place their faith in the efficiency of magnetic waters. While the obscurity of the subject is confessedly great, yet, on the whole, deposition by this means has seemed to involve fewer difficulties than if we assume the comparatively feeble agency of meteoric ground-waters. Nevertheless we are all aware that there are certain mining districts in this country, such as those containing the lead deposits of southeast Missouri, the gash veins with lead and zinc in the upper Mississippi Valley, and the zinc deposits of southwestern Missouri, near which no bodies of igneous rock are to be found. Aside from these cases, however, the general experience in the West is that somewhere near an orebody is usually a dike or some other intrusive mass to which we find

ourselves inclined to attribute a strong influence in producing the ore.

The Chairman.—Does anyone wish to ask questions of Professor Kemp?

Allen H. Rogers.—There is one matter of great practical importance that Professor Kemp did not touch: When we are looking at a vein, do we see the top of it or the roots? I believe that W. H. Emmons investigated this point, bearing on the sequence of deposited minerals.

J. F. Kemp.—Considerable thought has been devoted to this phase of vein filling. Lindgren has published a classification of minerals, based on their physical conditions of formation, as affecting the question of depth. W. H. Emmons has discussed the same general theme. The same general principles are the foundation of the scheme of classification formulated by Professor Lindgren in his invaluable work on "Mineral Deposits" recently issued. We know, of course, that gossan, limonite, and drybone are surface minerals. We used to think that chalcocite was a surface mineral; now we know that, in Butte, at least, it extends down to 3,000 ft. Certain minerals are persistent and are precipitated at all explored depths. The classifications of minerals along these lines are based on our observations in mines and experiments in artificial production. Even in their present shape, the classifications are useful, and we may eventually get a comprehensive scheme. As yet, we have not developed them far enough to use them extensively.

The Chairman.—Mr. Robert Sticht is with us this evening and will tell of his work in Australia.

Blast-furnace Practice at Mt. Lyell.

Mr. Sticht.—I have not much to say to-night except to appeal to your patriotic feelings. I went to Australia from Montana in 1895, to introduce American methods, and have always tried to keep the American flag flying. Indeed, much of my success has probably been due to my being an American and hence an outsider. I introduced a smelting process which was a mystery to the people there, and, from the theoretical side, to me also at the time. But I was given a free hand in every way, because I was an American and they had confidence in American engineers, and I confess that I feel more pride in that than in any purely technical successes. It is now exceedingly gratifying to me, coming back for a brief stay after such a long time, that what I have had the opportunity of doing should be recognized

by such representative men in so cordial and fraternal a manner.

Professor Kemp has treated a subject which has mystified us greatly: How did the ore get there? However, though interested in that question, we do not worry greatly over it at Mount Lyell. Our orebodies are wonderful, even though, in our case, we think we have only the "roots." In the Mount Lyell pyritic mass we may assume that we have the lower portion of a once much larger mass, into certain parts of which lower portion the meteoric waters, in times gone by, have concentrated the copper, silver, and possibly the gold contents of the upper portion, which is now gone by erosion. The country is heavily glaciated. In the very siliceous North Lyell, we find orebodies that resemble a bunch of carrots or sweet potatoes, they are so long and chimney-like, and there is reason to think that there was once a more pyritic body above them. The local geologists are careful, learned men, but they are eclectic, not original, and have not been able to devote sufficient time to a study of the deposition of this ore; I wish Professor Kemp would pay us a visit, if only for a few days. However, a manager's business is to make money, and he cannot devote much time to the question as to how his ore got there.

As regards smelting, when I arrived at Mount Lyell the pyrite method was still a problem. I had enjoyed opportunity to carry it out in its purity, for short periods, whenever the ores were suitable, in Montana and Colorado, and had no fear, on an empirical basis, that it would not be possible to carry it on continuously where the ore was so favorable as at Lyell. But, for my own satisfaction in fully understanding what went on inside of a furnace, I was made general manager too soon. I then had to look after the pounds, shillings and pence, and investigations of metallurgy, as such, had to be postponed.

Briefly, we started with three blast furnaces in 1896 and then installed converters. This plant was gradually enlarged to six blast furnaces. A second plant was built with five furnaces. When we abandoned hot blast, after six years' use, we pulled down the first plant and did all the work in the second. This plant received an extra furnace in the course of time, so that it has six, but we usually run only three furnaces. The most interesting development, perhaps, was the discarding of hot blast. I do not think I would now recommend it under any conditions.

Our furnace column reaches 18 ft. above tuyeres, and we use 64 oz. blast pressure. We base our work on the assumption that the inside of a furnace is occupied by a honeycombed mass of quartz, the passages of which are traversed by the blast and the molten sulphide, in opposite directions, the incandescent silica effecting simultaneous oxidation of the latter, by the oxygen of

the blast, and the union of the FeO, thus formed, with the silica itself. This forms the slag, while the unoxidized portion of the sulphide makes the matte. Our matte runs from 45 to 50%, rarely under 35%, and sometimes as high as 60 to 65% (a 20:1 concentration). When the matte becomes too high, we reduce the siliceous ore; when too low, we increase the latter. The proportion of pyrites in the charge is constant; also the limestone. The only variables are siliceous ore and coke, but the latter is changed much less frequently than the former.

As regards the percentage of coke used, I regret to say that the time when we got along with only 1½% (and sometimes as little as $\frac{1}{10}$%, with hot blast) is now merely historic. We are now under the necessity of smelting more of the siliceous ore, and, at the same time, the iron and sulphur in the pyritic ore have diminished, owing to the inclusion of a little galena and zinc-blende and a little more gangue. As a consequence, we now employ from 3½ to 5% coke, figured on the materials charged (except coke). The coke is our own make, but high in ash, and wet from the rainfall, which is 110 in. annually. Our slags are also more siliceous than they used to be, averaging 35 to 37% SiO_2 as against 30 to 32% in the past. The campaigns used to be three months or less; now they are a good deal longer, easily six months, the stoppages being caused by leaky jackets or the forehearth.

Concerning shape of bosh, I am unable to see that it makes any difference. The furnace creates its own internal lines, which may be entirely different from those of the designer. One can alter the position of the smelting zone, i. e., the focus, by changing the blast. The focus can be driven up by increased blast, in fact it may be driven clear to the top of the column.

You might think our works old-fashioned. We have kept fully in touch with all modern improvements and tendencies in the United States, but have not found that we could advantageously make use of the most striking ones. This is true as well of economic as of purely metallurgical points. Each furnace is run individually as regards momentary composition of charge, and the principal factor in their operation is the feeding. We have to be very particular about this, and cannot resort to mechanical appliances intended to serve unchanging average conditions of feed, because our process is so sensitive to variations in the relative proportions of silica, sulphide, and air, and to the physical way in which these three come together. You cannot run a number of pyritic furnaces all in the same manner and obtain our present grades of matte with satisfactory constancy. You would have to reduce the grade down to, say, 20%, and be satisfied to re-treat this.

You are probably accustomed to think of Australia as a wild and wooly country, where the laborers do nothing but strike. Australia is a country of diversified conditions, some portions being still in a pioneer state, and there a good many strikes occur; but, on the whole, the country is thoroughly civilized and the men with whom one has to deal are all of a good class. There are not many immigrants from the European continent, beyond a few Scandinavians, a few Italians, and a few Greeks, these last mainly fruit vendors, and not employed in the mines or smelters. There are none of the southeastern Europeans, no Hungarians, no Slavs. The majority of the mining and smelter employees are descendants of Englishmen or of Scotchmen. The miners are possibly not quite so efficient as their American confreres; the smelter men are. I have sometimes felt that a greater sprinkling of *good* Irish might be beneficial, by injecting more vim, Such of the Irish as make themselves noticeable are of the Hibernian anarchistic type.

Mr. Riordan (*interrupting*).—That's the kind of Irishmen they used to send to Australia.

Mr. Sticht.—No, it is said that at that time there were 200 crimes punishable by death, and I am afraid that the Irish referred to would have succumbed to these. The people who were transported were sent out for comparatively mild offenses, often only for stealing a handkerchief or for poaching, and their descendants are most law abiding.

I must say, in closing, that I went to Australia intending to stay two years, and have been there nearly twenty, which indicates that the environment and the conditions for professional work, have been attractive and stimulating.

D. H. Browne called attention to the fact that Mr. Sticht's practice was not applicable to all ores which contain sufficient sulphur and iron to smelt them. He stated that the Sudbury ores, which contains 35% of iron and 20% of sulphur were theoretically capable of treatment by this pyritic process, but that Mr. Beardsley, Mr. Guess and he, himself, had made many attempts so to smelt this ore, without success.

J. Parke Channing.—I wish to express my sincere thanks tonight to both Mr. Sticht and Mr. W. H. Freeland. About 15 years ago, when I was starting the operations of the Tennessee Copper Co., I heard of what Mr. Sticht was doing at Mount Lyell, in Tasmania, and Mr. Frank Klepetko kindly laid my problem before Mr. Sticht. He advised me that I had better not begin with pyritic smelting in Tennessee, but stick to heap

roasting. We spent $70,000 putting in roast yards, then smelted the ore with 13% coke, making a 40% matte in the first operation, which was then converted. We made money, and everyone was satisfied. I fear that if we had started on pyritic smelting I might have made a failure of it.

Shortly after this, Mr. Freeland, manager of the Ducktown Sulphur, Copper & Iron Co., whose property adjoined that of the Tennessee Copper Co., began pyritic smelting. At first his slags were too siliceous, and to correct them he tried adding iron ore. This only made matters worse; and eventually, after pounding away at it and trying all the various combinations, he found that what was necessary was to cut down the coke and add silica. To him is due the credit for the pioneer work in pyritic smelting in the Ducktown district.

Having the benefit of his experience, I took one of our 56x 180-in. furnaces, ran the ordinary roasted-ore charge down low, filled it up with the pyritic charge, with a minimum amount of coke, and the furnace ran perfectly. We found, however, that it did not make much better than a 10% matte, which was then concentrated in a second furnace and bessemerized. We were soon able to clean up the roast yards and operate entirely by the pyritic method. Incidentally, we noted an increased extraction, as apparently some inexplicable loss occurred in the roast yards, which we were never able to trace. We were never able to reduce the coke so far as Mr. Sticht did, nor were we able continuously to get so high-grade matte as he. As the furnaces are now operated, the question of matte-fall is of secondary importance, the most important object being to produce a gas which can be used in the acid chambers for the production of sulphuric acid.

The present aim is to yield a gas which will run about 6% SO_2 and 9% free oxygen, so that there may be enough oxygen to convert the SO_2 to SO_3 in the chambers. If the SO_2 is high, and the oxygen low, it will not do to add atmospheric air, because of the large amount of nitrogen thereby introduced, which dilutes the SO_2 below working requirements. The best way is to keep the coke down to a small amount so that too much of the free oxygen will not be consumed in burning this carbon.

For many years I had maintained to Mr. Browne that there was no reason why he should not smelt the Sudbury ores pyritically. He haunted the works of the Tennessee Copper Co. for over a year, trying to learn how to do it. About two years ago he engaged Mr. George A. Guess, who had been in charge of the Tennessee smelter, to try the experiment at Copper Cliff. Mr. Guess was given a furnace and blowing engine, and any kind of

ore and flux that he wanted. After about three months, I got two letters in the same mail; one from Mr. Browne saying that Mr. Guess had given it up, and the other from Mr. Guess himself saying that he could not smelt the ores pyritically and did not know why.

I have grave doubts whether nickel-copper ores can be smelted pyritically. Possibly there is some peculiar characteristic of the nickel sulphide which prevents the pyritic action from taking place. In addition, a large amount of the silica in the Sudbury ore is combined as a bisilicate, and the conditions in the furnace are not suitable for breaking up this combination. There is just a possibility that in a very high furnace the desired result might be obtained, though I am of the opinion that Mr. Browne will have to continue with his roast heaps, for the present at least. There is a possibility that in the Knudsen furnace the problem may be solved. There, none of the material can get away, and possibly the complicated reactions may take place.

A few days ago, Sr. Vicente Ortiz, owner of La Reforma mine in Guerrero, told me that when he took the mine nothing was visible but a gossan outcrop, and that all of his development has been based on articles written by Mr. Sticht, covering the conditions at Mount Lyell. He said that he was deeply indebted to Mr. Sticht for his success in developing La Reforma.

Mr. Sticht.—Matters, of course, were made easy for us in Australia by our having an extremely pure pyrite on the one hand, and a pure silica on the other. Possibly Mr. Browne's troubles came from the fact that his silica was combined.

Mr. Channing.—But Mr. Browne tried Creighton ore and pure quartz, and still could not accomplish pyritic smelting.

Mr. Browne.—One would think that it might be done in a Knudsen furnace. There you have a siliceous slag and a basic matte, and you merely have to blow.

Mr. Sticht.—But the conditions are not quite the same in both. In a blast furnace you find lumps of silica and lumps of pyrite in contact. In the Knudsen converter you find fused slag and fused matte; hence the blowing occurs under different conditions as to spacial distribution of air, sulphide, and silica, affording different facility for reaction.

Mr. Browne.—I do not see how pyritic smelting can be done on the Creighton ore. You have to burn 30% of iron to get the value of 10% of coke. Now, if you start with only 35% of iron, and have to burn off 30% of that to get the equivalent of your coke, where are you?

Mr. Sticht.—We burn off most of our iron in the Mount Lyell ores, that is to say, 95 to 96%, and in the burning it is also sacrificed and forms the slag. However, I am of the opinion that the materials must be in big lumps to do our work.

Mr. A. H. Rogers.—Is not the difference partly that in Australia you have pyrite ores, while Mr. Browne has pyrrhotite ores? The extra atom of sulphur may make a difference.

Mr. Sticht.—That, I think, is a misconception. Too much stress is often put on the utility of the sulphur in pyrites as a source of heat in this process. We do not burn that extra atom of sulphur; it goes off altogether by sublimation, is distilled. The FeS_2 turns practically to pyrrhotite at once, and even to something like Fe_5S_4, or Fe_4S_3, in the lower part of the furnace; and it is this particular sulphide which supplies the heat. In many ways, I think, a pyrrhotite ore is probably easier to smelt pyritically than a pyrite ore, but I may repeat that the most essential condition for the process is to have *free* SiO_2. What experience I had with pyrrhotite ores in Colorado made me feel that they were easier to treat than pure pyrites. In addition to keeping the throat more free, they seemed to run hotter. But it was necessary not to be afraid to reduce the coke, i. e., to a minimum which would ordinarily seem dangerous.

Mr. Channing.—I am greatly interested in Mr. Sticht's figures relating to an 18-ft. smelting column and a 64-oz. pressure. When Sr. Ortiz was here last spring he had a set of plans for a smelter drawn up by Krupp. I did not approve of them and spent part of a day sketching out a plant, making the furnace 20 ft. from feed floor to tuyeres. When he was here a few days ago, on his return from Germany, he showed me the revised plan drawn by Krupp, whose engineer had again made the furnace 16 ft. from feed floor to tuyeres. I again told him that it was wrong and that he needed more height of column, although I did not know exactly what height was necessary. Mr. Guess, in referring to the improvements he had made at Anyox, said that he threw the charge into the middle of the furnace; to do this you must have plenty of headroom for your charging, even if you do not fill the furnace completely.

In building the Tennessee plant we installed a separate blowing engine for each furnace, and obtained a better result than later, when all the furnaces were connected to one blast main, again showing the necessity for individual operation upon which Mr. Sticht had insisted.

Mr. Sticht.—One ought to have several feet leeway in the height of his smelting column. In reconstructing the Mount

Lyell works, I raised the charge floor 8 ft. above the former one. A separate blower for each furnace is desirable if one can afford it, but that is only a minor point when there are not too many furnaces. When formerly using hot blast, the stoves standing between blowers and furnaces, it complicated matters to have a blower for each furnace, and we did not do that at Mount Lyell. Our practice now is to supply about 20,000 cu. ft. of cold, free air per minute to each furnace. The 64 oz. pressure is only an incidental feature of the blast, and is due merely to the resistance encountered in forcing a given volume of air through a certain size of tuyere in a given time. Roughly speaking, it is volume rather than pressure that counts.

Regarding the composition of our furnace gases, since the figures were first published, we have occasionally repeated the analyses, and still find practically no oxygen in the gases leaving the furnace, nor at a depth of 7½ ft. below top of the column. The determinations were last made a few months ago, with a water-cooled apparatus.

Mr. Rogers.—Is the top of the charge hot, in your practice?

Mr. Sticht.—Yes; or rather, I should say that it looks so. This is due to the large amount of sulphur distilling off, which burns as it comes in contact with oxygen of the air above the charge. It is possible to run the furnace on matte and pyrrhotite with a satisfactorily cold top. On pyrites, however, this is impracticable, for this low temperature can be achieved only by operating in a manner which leads to rapid formation of crusts around the throat. We run, therefore, so as to avoid crusts, and thus appear to have a fiery throat. One must, however, not contemplate the combustion of the sublimated elemental sulphur, but judge throat conditions rather by the phenomena at the top of column. The top of the furnace is really not hot, for the pieces of charge glow slightly only around the walls, and are black and cold over the full inner area of the top. Between these cold pieces a whitish flame is visible, which changes into a heavy cloud of sulphur vapor, a foot or two above the top of charge; this then ignites and forms the usual dense white smoke characteristic of the work. The furnace acts as its own crusher; all materials are charged in as massive lumps as the men at the mines and quarries can readily handle. Possibly, if we crushed them first, they would so decrepitate in the furnace that the latter would choke tight, and we could not practice pyritic smelting at all.

Mr. Channing.—We used to watch the pressure gauges at the furnaces in Tennessee, but finally found that we could tell

nothing that way, and we removed them all. It took about a month to train the foremen to run the furnaces by counting revolutions of the blower. That is the way to run a pyritic furnace.

After a little more desultory discussion of pyritic smelting, the meeting adjourned at 10 p. m.

D. M. LIDDELL,
Secretary of Section.

SAN FRANCISCO.

On Nov. 16, 1914, a homecoming dinner was given in honor of Mr. F. W. Bradley, who had recently returned from Alaska. The dinner was served in the Palace Hotel. The secretary deems it worth noting that the excellent dinner, thanks to Mr. Merrill, contained a palatable gastronomic novelty—"California salad"—consisting of ¾-in. balls of Cassava melon served on lettuce, with a mild French dressing.

The following members and guests were present: H. F. Bain, E. H. Benjamin, F. W. Bradley, E. T. Blake, A. Burch, H. C. Callahan, S. B. Christy, G. H. Clevenger, C. G. Dennis, C. C. Derby, E. A. Hersam, J. M. Hyde, E. Juessen, H. A. Lardner, C. W. Merrill, F. L. Morris, C. H. Munro, S. W. Mudd, F. A. Probert, W. H. Shockley, F. R. Short, Howard D. Smith.

After dinner, Mr. Bradley was welcomed appreciatively by Professor Christy, chairman. In replying, Mr. Bradley mentioned some matters that he thought might interest the Society. He spoke of the new mills of the Alaska-Juneau and adjoining companies, and of the milling methods to be used. A duty of 17 tons to the stamp is expected in the Alaska-Juneau mill. An interesting fact is that the gold in this ore is coarse, while the slimes carry but 10c. per ton, and will be thrown away.

The great size of the deposits was pointed out: the width is from 500 to 900 ft., with a height above the sea level of 2,000 ft. and a probable depth of at least the same distance. The length in the Alaska-Juneau is 7,500 ft., and the total length, including the adjoining mines, 20,000 feet.

Mr. Bradley also referred briefly to the experiments now being made at the Bunker Hill & Sullivan mines on the Malm dry-chlorination process. A 50-ton unit has been built. This process produces metallic lead and zinc and saves the precious metals. The destructive action of the chlorine employed, and the electrolysis of the zinc chloride, have offered difficult problems, but they are now considered as solved. It is felt that the process has every chance of commercial success.

Mr. S. W. Mudd spoke of the platinum deposits recently

found in place in southern Nevada, the only other known deposit of vein platinum being in Wyoming. Narrow seams of platinum ore are said to be found in the Urals, in peridotite.

Mr. C. H. Munro spoke of black sands near Coos Bay, and suggested that the failure to work black sands profitably is due to the limited quantity of rich sands available.

W. H. SHOCKLEY,
Secretary of Section.

OBITUARY

Samuel Benedict Christy, a charter member of the Mining and Metallurgical Society of America, for several years a member of its council, and at the time of his death, chairman of the San Francisco Section, died suddenly, Nov. 30. By his death the Society loses one of its most loyal and interested members, and the engineerng profession loses one of its great names. The following appreciation of his character and work was written by his old friend, R. W. Raymond:

The death of Prof. Samuel Benedict Christy on the 30th of November, at the age of 61 years, cuts short a brilliant and influential professional career. He was born in San Francisco, Aug. 8, 1853, and was graduated as Bachelor of Philosophy at the University of California in 1874. For the five years that followed, he studied mining and metallurgy as a post-graduate in the same institution, serving also as instructor in analytical chemistry, and becoming in 1879 instructor in mining and metallurgy—a position which he held until 1885. During this period he became known also by his contributions to technical literature, the earliest of which, perhaps, was his report on the Monte Diablo coals (in 1875); but the first which drew my attention to him was an exceedingly able discussion (in 1879) of the genesis of the quicksilver deposits of California, in which he followed with much acuteness and originality the lead of Professor Becker, who had been teaching at the University of California. The notion of the thermo-aqueous formation of such deposits was then new; and the laborers in a field now familiar to every student deserve the credit due to pioneers.

For some years the subject of quicksilver seems to have occupied much of Christy's attention. In 1877, he described the mines and works at Almaden, Spain; in 1884, the Imperial quicksilver works at Idria, Austria; in 1889, the New Almaden mines of California.

But his great work was the creation of the school of mining and metallurgy at the University of California, which may be

said to have begun with his occupancy of a full professorship of these branches. It is not necessary here to recount the early difficulties and perils of the University, and its long struggle for academic independence of political control or interference. The battle is over, and the institution is now upheld by the intelligent loyalty of the citizens of California, without regard to party. But while the issue was uncertain, the development of special schools of applied science was scarcely practicable. Doctor Becker and William Ashburner had given up the school of mines as a hopeless task when Christy, younger and less experienced, took it up. As he wrote me in February, 1901—

> I took an empty building without equipment, and with half a dozen students. Now I have a fully equipped department, adapted to our local needs better than any I have seen in the world. I have now nearly 250 students; and I am willing to compare the record of our graduates, now scattered all over the world, with that of any other institution of equal age.

The secret of this success lay in the enthusiasm, pertinacity, industry and personal charm of Christy himself. He was able not only to inspire his students, but to impress upon their parents and the public at large the value of the thorough training given them under his direction. His own example was contagious. Besides the practical labors of his office, he prosecuted laboratory researches of the most delicate and complicated character, in which it was a privilege for any student to be his assistant.

Before the famous Hearst building was erected and equipped for the School of Mines, Professor Christy traveled through Europe, inspecting the great laboratories and plants of technical instruction. By that time, his work had made him widely known; and I remember still with what simple-hearted surprise he expressed his gratitude for the reception he had encountered abroad.

Yet this already illustrious teacher, investigator, organizer and leader, who was delivering every year to scores of young graduates their diplomas as mining or metallurgical or chemical engineers, held no degree himself, except the primary baccalaureate in philosophy, required before he began his technical course. The reason was that in 1879, when he finished that course, the University of California was not yet granting technical degrees.

In 1902 Columbia University put an end to this anomaly by conferring upon the head of the California University School of Mines—one of the foremost rivals of its own school—the honorary degree of Doctor of Science. This graceful recognition was creditable alike to giver and recipient, and it was a great joy to Professor Christy, after his long and arduous labors in a distant

field, to be thus received into the academic brotherhood. He traveled extensively at that time in the Eastern States and the Lake Superior region, studying everywhere with keen observation the methods and appliances of mining and metallurgy. In June, 1902, just after he had received his doctor's gown, he wrote me:

> We went to-day through the subway with Mr. Parsons and examined the part where the landslide took place. They secured the mining ground in a most original way—ran in several thousand barrels of cement grouting —and are now drilling and blasting out the cemented ground. Verily, you do wonders here in New York!

I cannot at this time present a complete catalog of Professor Christy's published works and professional activities. A man so intensely and continuously active in so many directions leaves "footprints on the sands of time" too numerous to be traced and interpreted by a hurried reporter. I know that he discussed in 1891 the practice of chlorination at the Alaska-Treadwell mine; that he was engaged for a series of years in the U. S. Circuit Court as an expert in the metallurgy of quicksilver and of lead; and that in 1900, as the result of patient and thorough experiment, he patented an improved process for the recovery of gold and silver from dilute cyanide solutions. And I know that to the Transactions of the American Institute of Mining Engineers (of which he became a member in 1883, and was a vice-president in 1891 and 1892) he contributed a series of highly original and important papers on the metallurgy of gold, silver and mercury, and on the training of mining engineers and the relation of American mining schools to the mining industry, as well as a remarkable biographical notice of Joseph Le Conte, his friend and colleague, which has been recognized as the most appreciative and satisfactory of the tributes paid to that illustrious and beloved leader and teacher. But beyond this list, which is enough of itself to secure for Professor Christy a permanent place in the history of American scientific and technical progress, there remains his work in connection with the California Academy of Sciences (of which he was a life member, and for five years corresponding secretary), the Society for the Promotion of Engineering Education (of which he was three years vice-president), the California Miners' Association and other bodies.

I cannot altogether forbear, though I hesitate, to speak of more sacred things—of his marriage in 1881 and the companion who is left desolate by his departure; of the anguish which they suffered in the death of a son on whom their hopes were set; of the close sympathy into which I was then drawn, by reason of my own similar bereavement, and of the unbroken loyal friendship, both before and after that event, which time did not, and death

SAMUEL BENEDICT CHRISTY

cannot, impair. I rejoice that a quick and peaceful end has crowned a fruitful life, and that the bright, strong spirit of my dear friend, "crossing the bar," went out to sea through the Golden Gate he knew and loved so well.

OTHER SOCIETIES

The American Society of Civil Engineers has adopted a code of ethics by a letter-ballot vote of 1997 to 107. This code of ethics is as follows:

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

(1) To act for his clients in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.

(2) To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects or business of another engineer.

(3) To attempt to supplant another engineer after definite steps have been taken toward his employment.

(4) To compete with another engineer for employment on the basis of professional charges, by reducing his usual charges and in this manner attempting to underbid after being informed of the charges named by another.

(5) To review the work of another engineer for the same client, except with the knowledge or consent of such engineer, or unless the connection of such engineer with the work has been terminated.

(6) To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

PERSONALS

H. C. Bellinger has gone to Chile to make a report for the Braden Copper Co. on some of its property.

H. C. Hoover, who was prominent in the work of aiding Americans in England after the outbreak of the war has now turned his attention to the needs of the suffering Belgians, and is playing an important part in the relief measures for that country.

J. E. Johnson, Jr., lectured before the Franklin Institute on Oct. 8 on "Recent Developments in Cast-Iron Manufacture."

Prof. Andrew C. Lawson has been appointed dean of the School of Mining of the University of California in place of Samuel B. Christy, recently deceased.

J. H. Polhemus has resigned as manager of mines with the American Zinc, Lead & Smelting Co., to become assistant manager of mines for the New Jersey Zinc Co., with headquarters in New York.

A. L. Queneau was at Soissons with the French heavy artillery, according to letters from him dated late in November. He was at that time in good health and in excellent spirits. Later he was transferred to the British base at Havre to act as interpreter and he was there in the latter part of December.

Prof. Robert H. Richards was tendered a complimentary dinner in Boston on Nov. 27, in recognition of his 50 years' service as a devoted alumnus and teacher of the Massachusetts Institute of Technology, and in expression of the respect and affection in which he is held by the corporation, faculty, and alumni of the institute.

Walter Harvey Weed, who purchased the Horace J. Stevens "Cooper Handbook" business, following the death of Mr. Stevens, and has continued the business at Houghton, Mich., since that date, has decided to move the office of publication of the "Handbook" to New York and the work now is under way.

Edward S. Wiard, has been in New York on professional business. His book on the "Theory and Practice of Ore Dressing," is in type, and will soon be published.

CHANGES IN ADDRESS

Wright, Louis A. .....286 Grand St., Newburgh, N. Y.

Kinzie, R. A. .....First Nat. Bank Bldg., San Francisco, Cal.

Mining and Metallurgical Society *of* America

CONSTITUTION BY-LAWS

RULES

OFFICERS MEMBERS

March 1, 1914

505 Pearl Street, New York

OFFICERS FOR 1914.

President, JAMES F. KEMP, Columbia University, New York.

Vice-President, J. R. FINLAY, 52 William St., New York.

Secretary, Treasurer, } W. R. INGALLS, 505 Pearl St., New York.

Executive Committee: Messrs. J. F. Kemp, J. R. Finlay, W. R. Ingalls, J. Parke Channing and H. S. Munroe.

COUNCIL.

At large, ex-officio.
James F. Kemp, New York ..... Retires January, 1915
J. R. Finlay, 52 William St., New York ..... Retires January, 1915
W. R. Ingalls, 505 Pearl St., New York ..... Retires January, 1915

Districts 1-2-3.—New York and New England.
George C. Stone, New York ..... Retires January, 1915
H. S. Munroe, Columbia University, New York .... Retires January, 1916
J. Parke Channing, New York ..... Retires January, 1917

Districts 4-5.—New Jersey, Pennsylvania, West Virginia and Ohio.
F. Lynwood Garrison, Philadelphia ..... Retires January, 1915
R. A. F. Penrose, 460 Bullitt Bldg., Philadelphia ... Retires January, 1916

District 6.—District of Columbia and Southern States.
Hennen Jennings, Washington, D. C. ..... Retires January, 1917

District 7.—Michigan, Minnesota, Wisconsin, Illinois, Iowa and Missouri.
P. N. Moore, St. Louis, Mo. ..... Retires January, 1917

District 8.—Colorado and Utah.
Philip Argall, Denver ..... Retires January, 1915

Districts 9-10.—Oregon, Alaska, Northern California and Philippine Islands.
H. F. Bain, San Francisco ..... Retires January, 1917
F. W. Bradley, San Francisco ..... Retires January, 1915

District 11.—Arizona, Mexico, Texas, Oklahoma and Southern California.
S. W. Mudd, Los Angeles ..... Retires January, 1916

District 12.—Montana, Idaho, Washington, Canada and Nevada.
C. W. Goodale, Butte ..... Retires January, 1916

OFFICERS OF SECTIONS.

SAN FRANCISCO.

S. B. Christy, *Chairman.*
P. R. Bradley, *Secretary.*

NEW YORK.

E. G. Spilsbury, *Chairman.*
H. S. Munroe, *Vice-Chairman.*
Louis D. Huntoon, *Secretary.*

PHILADELPHIA.

F. Lynwood Garrison, *Chairman.*
R. H. Sanders, *Secretary.*

Editor, Edward K. Judd

CONSTITUTION.

Amended, Oct. 4, 1911.

1—Name.

The name of the association shall be Mining and Metallurgical Society of America.

2—Objects.

The Society shall have for its objects the conservation of mineral resources, the advancement of mining and metallurgical industries, the better protection of mine investors and mine workers, the increase of scientific knowledge, and the encouragement of high professional ideals and ethics.

3—Membership.

The Society shall comprise honorary members, and members who must be qualified by knowledge, experience, and honorable standing to advance the objects of the Society, and shall be proposed for, and elected to, membership as provided in the by-laws of the Society.

4—Members.

All interests in the property of the Society of persons resigning, or otherwise ceasing to be members, shall vest in the Society. No member or officer shall receive salary, compensation, or emolument unless authorized by the by-laws, or by concurring vote of two-thirds of the council. Members residing for a year or more beyond the limits of the United States, Canada and Mexico, shall not be entitled to vote nor to hold office during the period of such residence.

5—Officers.

The affairs of the Society, subject to the provisions of the constitution and by-laws, shall be managed by a council of fifteen members, who shall hold office for the prescribed term or terms. The executive officers of the Society shall be a president, a vice-president, and a secretary (who shall also be treasurer), which officers shall be members of the council ex-officio, and shall hold

office for one year, or until the close of the meeting at which their successors in office are elected, except that the secretary shall hold office until his successor accepts transfer of the duties of that office. Additional officers may be elected by the council from time to time if necessary for the purposes of the Society. All officers shall be eligible for re-election. Vacancy in the office of president shall be filled by the vice-president, who shall then become president, and the council shall forthwith elect a vice-president; and if necessary shall elect a member of council, of which the number must always be fifteen.

6—Annual Meeting.

The annual meeting of the Society shall be held on the second Tuesday in January of each year. One-third of the members, present in person or by proxy, shall constitute a quorum for the transaction of business.

7—Rules.

The Society may adopt by-laws, rules and regulations for the conduct of its business, provided that these are in harmony with this constitution, and may provide different methods for amending or repealing such by-laws, rules and regulations.

8—Amendments.

Amendments to the constitution may be presented at a regular or business meeting of the Society; and if endorsed by the council, or in writing signed by at least twenty members, a copy of such proposed amendment shall be sent to all entitled to vote, accompanied by comment by the council if it so elects, at least thirty days in advance of a second meeting called for its consideration; at which meeting the amendment may be amended as to wording but not as to intent, and then shall be submitted to a final vote by sealed letter ballot sent to all members; the polls shall be open for sixty days, and for the adoption of the amendment a majority of those entitled to vote shall be required to have been recorded in the affirmative; provided, however, that a negative vote comprising a majority of the votes cast shall defeat the amendment. If the necessary vote for adoption or for rejection is not secured on the first ballot, the council shall order the sending of a second ballot by registered mail to members who have not recorded their vote; and in such case, so many of these second ballots as have been received by members, if not voted within a further period of sixty days shall be counted as votes cast in the affirmative. The ballots shall be voted, canvassed and announced as provided in the by-laws.

BY-LAWS.

Amended Sept. 5 and Oct. 4, 1911, and Mar. 13, 1913.

1—Admission to Membership.

A candidate for membership or two members proposing him shall submit, in such form and in such detail as may be prescribed in the rules and regulations of the council, a record of his training and practice. The candidate must have had eight years' practical or professional experience, including not less than five years in positions of responsibility in mining or allied lines of work. Graduates of approved engineering schools shall be credited with one-half the time prescribed for graduation. The candidate must be endorsed by three or more members who shall further certify in writing as to his qualifications for membership. These statements must be based on long or intimate personal knowledge, and shall be submitted in such manner as the council may direct. The names of the candidates, after approval by a duly appointed committee of the council, shall be submitted to all members of the Society entitled to vote, with the request that said members of the Society present in writing promptly, any objections that they may have against a candidate on the list. Thirty days after the mailing of the list, the committee of the council shall consider the communications received from members of the Society, and with the approval of the committee, the secretary of the Society shall then submit the name of the candidate to the whole council for secret letter ballot. The affirmative votes of a majority of the council shall be required to elect, but three adverse votes, received within thirty days, shall be sufficient to defer the election of any candidate, and the council may include the name of any such candidate on the ballot for any subsequent election of members. The application of any candidate shall be considered as pending unless it be withdrawn, or unless by a majority vote of the council the candidate be rejected. A candidate may renew his application a year or more after his rejection.

2—Admission to Honorary Membership.

Honorary members, not to exceed ten in number, must be proposed in writing, setting forth at length the qualifications of the candidate, and signed by at least twenty members of the Society. The candidate must be elected by vote of the council which shall be by sealed letter ballot. One dissenting vote shall defeat such election. Honorary members are not entitled to vote nor to hold office and shall not be required to pay initiation fees nor annual dues.

3—Subscription to Constitution and By-Laws.

All elected candidates shall be duly notified, and shall subscribe to the constitution and by-laws in such form as the council may direct. This latter provision shall not apply to honorary members. The membership of any person shall date from the day of his election.

4—Annual Dues and Life Membership.

The annual dues shall be ten dollars, payable in advance on the first day of January of each year. Persons elected after nine months of any year have expired shall pay only one-half of the dues for that year. The council may, for sufficient cause, remit the whole or part of dues in arrears. The executive committee of the council may drop from membership any member more than one year in arrears for annual dues, but may reinstate such member at its discretion. The council shall permit any member, not in arrears, to become a life member on payment of a sum deemed adequate for the purpose by the council, and based on his expectation of life according to reliable tables of mortality. Such life membership and initiation fees shall be invested, and the income only shall be applied to the current expenses of the Society.

5—Resignations.

Any member, not in arrears in payment of dues, may terminate his connection with the Society by sending his resignation in writing to the secretary.

6—Discipline.

The membership of any person in the Society may be suspended or terminated for reasons of weight by a four-fifths vote of the council. Notice of such intended action shall be sent to such member by registered mail, and action shall not be taken for at least thirty days after the receipt of this notice by such member. A member suspended or expelled may demand a sealed letter ballot sustaining the action of the council. This ballot shall be sent to all members entitled to vote and may be accompanied by a statement signed by the council or a committee thereof, and by a statement on behalf of the accused of not more than one thousand words, or not exceeding in length that prepared by or for the council. A majority of the votes received within thirty days shall be required to reverse the action of the council.

7—Election Districts.

The council shall from time to time divide the territory occupied by the membership into twelve geographical districts to be designated by numbers. Each of the districts shall be, as nearly as practicable, contiguous territory; and each shall contain as nearly as practicable an equal number of members. The council shall announce such division to the Society three months before the annual meeting. The council shall consist of the president, the vice-president and the secretary; and of twelve members, elected one from each district, and the terms of office of such twelve councillors shall be arranged so that four of them shall expire each year.

8—Officers.

The officers of the Society, as provided in the constitution, shall be elected as hereinafter provided, except that whenever a vacancy occurs it shall be filled by a majority vote of the council. Their respective terms of office shall begin at the close of the meeting at which they are elected. The duties of the several officers shall be such as usually attach to the office, or such as may be determined by the council. The council may delegate its powers to persons or committees, and may make such rules and regulations as may be necessary for the proper conduct of the business of the Society, provided that these are in harmony with the constitution and by-laws.

9—Councillors.

The term of office of a councillor shall begin immediately upon election. Vacancies occurring at any time in the council may be filled until the next annual election by a majority vote of the remaining members. At the next annual election new councillors shall be elected to fill such vacancies for the unexpired terms of office only.

10—Nominations.

Three months before the annual meeting, the secretary shall send a nomination ballot to each member of the Society in the districts for which new councillors must be elected, with the request that he shall nominate three members, in such manner as the council may direct, as candidates for councillor to represent his district; and shall send a nomination ballot to each member of the Society entitled to vote, with the request that he shall nominate one member for president, one for vice-president and one for secretary. Nominations shall be received for 20 days, when the polls shall be closed and the ballots counted by the Secretary. Sixty days before the annual meeting the Secretary shall issue a ballot, con-

taining in and for each of these districts not less than three names, and for the offices of president, vice-president and secretary, each, not less than three names, which shall be in each case those receiving the largest number of nominating votes. Provided, however, that the ballot may comprise less than three names for any office if less than three persons have been nominated for that office; and, moreover, that persons receiving less than seven votes for an executive office and less than three votes for councillor may be disregarded, and provided further, that no person may stand for more than one office, and when votes are cast for the same person for more than one office he shall be placed on the ballot only for that office for which he has the largest number of votes. The ballot prepared as thus directed shall be mailed to each member of the Society entitled to vote, who may vote for one councillor in each district, having the right to substitute names not on the list, and to cast not over three votes for a single candidate, provided that the total number of votes cast by such member shall not exceed the total number of vacancies to be filled; and who may cast one vote for president, vice-president and secretary, respectively, having the right to substitute names not on the list. The ballot shall be signed, sealed and voted as prescribed in by-law 15.

11—Canvassing Ballots for Councillors.

At noon of the first day of the annual meeting the polls shall be closed and the ballots counted by two tellers appointed by the president. Councillors shall not be eligible for such appointment. The candidate for councillor in each district, and the candidate for the respective elective offices, receiving the largest number of votes, shall be elected. In case of a tie the president shall cast the deciding vote.

12—Meetings of Council.

Meetings of the council for the transaction of business may be called at any time by the president, and shall be called at the request in writing of three councillors. Unless for reasons of weight, at least ten days' notice of meetings shall be given. Five councillors, present in person or by proxy, shall constitute a quorum. A letter ballot of the council shall be taken on any question of importance, if so ordered by the presiding officer at any meeting, or at the request in writing of three councillors. Whenever a letter ballot of the council be taken, a majority vote of the council shall be required to pass the motion put to ballot, except that letter ballots upon candidates for admission to membership shall be decided as provided in by-law 1.

13—Meetings of the Society.

The council shall provide for regular stated meetings of the Society, for the transaction of business, or for the reading or discussion of papers, to be held at such times and places as may best serve the interests of the Society. Special meetings of the Society, or of any section thereof, for a definite purpose, may be called by the president, or shall be called on a request in writing signed by twenty members. It shall not be in order at a special meeting to transact other business than that stated in the call for the meeting. Except for reasons of weight, at least thirty days' notice shall be given of all meetings. Except at annual meetings, ten members present in person or by proxy shall constitute a quorum. Resolutions endorsing or condemning matters of public or professional interest shall take such course as may be prescribed by the council in duly formulated ruels, but such rules must provide that not less than thirty days be allowed for any ballot of the membership of the Society.

14—Local or Professional Sections.

Local sections, or professional groups of members of the Society, may be organized for social, scientific and professional purposes, in harmony with the constitution and by-laws, and such sections shall have only such powers, and shall act under such rules and regulations as the council may from time to time approve.

15—Sealed Letter Ballots.

When sealed letter ballots are required by the constitution or by-laws, the envelope to contain the ballot shall be so designed that it can be signed on the outside by the voter for identification, and can afterward be opened by the tellers so as to preserve the secrecy of the ballot. The endorsement may take the form of a proxy, to be voted by the tellers appointed by the president, or by such other person, not a councillor, as the member may designate. The ballots signed and sealed shall be mailed or delivered to the secretary, who shall be responsible for their safe-keeping, and who shall endorse thereon the date and time of receipt and make record of such receipt on a list of members kept for the purpose. Any member shall have the privilege, at any time before the closing of the polls, of substituting another ballot, in which case the original shall be returned to him unopened. After the closing of the polls, the ballots, arranged in alphabetical order, with the check list of members above mentioned, shall be delivered by the secretary to tellers appointed by the president. The tellers shall verify the check list, and open and mix thoroughly the votes in such manner as to preserve the secrecy of the ballot. The ballots after being counted by the tellers, shall be destroyed, and the report of the tellers shall be the

official record of the vote. In case a supplementary ballot shall be ordered for members failing to vote on the first ballot, the members whose votes have been counted shall not be permitted to vote a second time nor to change their original vote. The result of the ballot shall be communicated to the members of the Society at such time and in such manner as the council shall determine.

16—Vote of Confidence.

The council, by a two-fifths vote of its members, or upon request in writing of twenty per cent. of the members of the society, shall submit any question to the membership for a vote of confidence. Such vote must be inaugurated within fifteen days after a motion for a vote of confidence has been passed; and the majority of votes received within thirty days after issuance of the ballot shall decide. In case such question is decided against the council, the members thereof shall forthwith resign office, their resignations to take effect on the election of their successors, and a new election of the whole council shall be immediately ordered to be conducted as provided in the by-laws. The new councillors shall by lot divide themselves into three classes to serve until the next annual meeting and for one and two years thereafter respectively.

17—Amendments to By-Laws.

Amendments to the by-laws shall take the course provided for amendments to the constitution, save that when the letter ballot is taken a majority of the votes received within thirty days shall pass or defeat such amendments.

RULES AND REGULATIONS.

A.—Rules Governing Resolutions.

1. Resolutions upon matters of interest to the Society, or upon matters that it is desired to submit to the entire membership of the Society, other than amendments to the constitution and by-laws, may be introduced at any meeting of any local section. Upon adoption by such section, the secretary of the section shall communicate the resolution as adopted to the secretary of the Society, who shall promptly lay it before the council. The council, after consideration of such resolution, shall (1) submit it to the membership of the Society for vote by letter ballot as provided in the by-laws; or (2) make such amendment as in the opinion of the council is desirable, without, however, altering the intention of the resolution, and then shall submit it to vote by the Society; or (3) reject the resolution and return it to the section that communicated it, with the reason for rejection.

2. A local section when notified by the council of the rejection of a resolution may reiterate that resolution; and upon receipt by the council of report of such action, the council shall then promptly submit the resolution to the membership of the Society, without amendment, but the council may accompany the resolution with a memorandum respecting its own action in the case.

3. If the council receives resolutions bearing upon the same subject from two or more local sections, the council shall select for submission to the Society that which in its opinion is the most adequate for the purpose intended; or the council may frame a composite resolution, to which new matter may be added, and shall submit such resolution to the membership of the Society as a resolution proposed by the council in lieu of those adopted by two or more local sections.

4. Any seven members of the Society, not affiliated with any local section, may unite in presenting a resolution to the council, and the council shall act upon such a presentation in the same way as provided under rule 1.

5. The council itself may initiate a resolution and submit it directly to the membership of the Society for letter ballot.

B.—Rules Governing Local Sections.

1. Local sections of the Society may be formed for promoting social intercourse among members, and for reading papers, and discussing subjects pertinent to the objects of the Society, and not inconsistent with the constitution and by-laws of the Society.

2. Such sections may be organized wherever there be 15 members in any city or town, or in places adjacent thereto, upon the re-

quest of 10 or more of such members addressed to a councillor, who may thereupon call a meeting of members residing within the limits of the proposed section, and if not less than seven members attend such meeting, they may thereupon organize such section, elect officers, comprising at least a chairman and a secretary, and adopt rules and regulations for their local government, not inconsistent with the constitution and by-laws of the Society; provided that said rules and regulations, or any subsequent amendment thereof, shall forthwith be submitted to the council of the Society, and shall not become effective until approved by the council; and provided, that all members of the Society residing or engaged professionally in the district included by any section shall be invited to become members of said section; and provided that any such member, upon application and upon complying with the rules and regulations of said section, shall be admitted to membership therein; and provided that all expenses incurred by said section, except as noted below, shall be defrayed by said section.

3. The secretary of each local section shall notify the secretary of the Society as to the names of members enrolled in his section and shall promptly inform the secretary of the Society respecting any resignations from or additions to membership. In the event of any dispute as to membership, or the right to enroll members, the matter shall be referred to the council of the Society, whose decision shall be final.

4. The Society will pay, on request, two-thirds of the actual cost of stenographic reports of the meetings of any section, provided that the amount so paid does not exceed one-half the dues paid into the general treasury by the members of such section, nor exceed $100 in any one year.

5. Dues or assessments for the defrayment of the expenses of local sections shall be levied as each section shall determine, but shall not exceed $5 per member in any one year. The failure of any member to pay such section-charges shall be reported to the council of the Society and delinquency for more than one year after notice has been served shall be a reason sufficient for the suspension or termination of the membership in the Society of such delinquent member. Any member not in arrears in payment of section-charges may terminate his connection with any section by written notification to the secretary thereof. If by resignation, or otherwise, the membership of any local section shall fall below 15, the existence of such section may be terminated by the council.

6. The proceedings of local sections, including papers and discussions, shall be reported to the secretary as hereinafter provided. No section shall, without the approval of the council of the Society, permit any account of its proceedings or of its papers or discussion to be printed in any newspaper or technical publication, nor shall any

such section print or publish any proceedings, without the assent and approval of said council, nor issue any printed matter, except the necessary notices, etc., relating to the management of the section. No section shall at any time perform any act or deed which is properly a function of the Society.

7. The geographical limits of each local section shall be subject to such amendment or limitation as the council of the Society may from time to time determine.

8. All members of the Society shall have the right to attend all meetings of all sections.

9. Honorary members of the Society shall be exempt from dues to any local section.

10. The order of business at meetings of local sections shall be:
   a. Reading of minutes of previous meeting.
   b. Transaction of business.
   c. Discussion of professional and technical questions.

11. The proceedings at each meeting of each section shall be promptly reported by the section-secretary to the secretary of the Society.

C.—Rules for Award of Annual Medal.

1. A gold medal shall be awarded by this Society each year for conspicuous professional or public service for the advancement of the science of Mining, of Metallurgy, or of Economic Geology; for the betterment of the conditions under which these industries are carried on, for the protection of mine investors, and especially for the better protection of the health and safety of workmen in mines and metallurgical establishments.

2. This medal shall be awarded at the annual meeting of the Society in January.

3. Six months before the award the Secretary shall send a circular letter to all members requesting suggestions as to the specific object for which the medal shall be awarded and asking for the nomination of candidates on a form provided for the purpose, such nominations to be accompanied by a full statement of the claims of the candidates for consideration. These nominations shall not be confined to members of the Society and may include other nationalities than our own.

4. Four months before the award of the medal the council shall determine the specific object for which the medal is to be awarded. All nominations of candidates whose claims to recognition lie in that special field of work shall then be considered by a committee of three to be appointed by the President. At least two

months before the award this committee shall submit a list of two names to the council with full statement of the claims of each candidate. The committee may consider and recommend names not nominated by members of the Society. The names so recommended shall be submitted to the council for election by letter ballot.

5. For the election of a candidate a majority vote of the council shall be necessary. If this majority be not obtained on the first election other ballots may be taken either by letter or at a meeting of the council called for the purpose. At such meeting members of the council may be represented in proxy.

D.—Rules for Publishing the Bulletin, and for Reporting Minutes of Local Sections.

1. The Society shall publish monthly (and at intermediate times when necessary) a bulletin, which shall be the official record of the proceedings of the Society, and of its local sections. The bulletin shall be published under the direction of the Secretary of the Society and shall contain announcements by the officers, the minutes of meetings of local sections, communications from members, and such other matter as in the opinion of the council or of the officers of the Society may be proper and useful in promoting the purposes of the Society.

2. The regular numbers of the bulletin shall be published on the last day of each month, or as near thereto as is possible, but the council may for reasons of weight delay the publication of any bulletin.

3. Secretaries of local sections shall be responsible for the primary editing of the reports of meetings of their sections and shall deliver to the Secretary of the Society a properly prepared manuscript report, in duplicate, each copy signed by the section-secretary.

4. The Secretary shall file one of these copies among the official records of the Society and shall use the other copy in connection with the preparation of the bulletin.

5. Matter intended for publication in any bulletin must be delivered to the Secretary of the Society before the twentieth day of the month of publication, unless the publication of the regular bulletin has been delayed by direction of the council.

6. The Secretary may, for reasons of weight, withhold matters submitted for publication in the bulletin, other than official announcements by the officers of the Society or by the council; but in the event of such withholding he shall forthwith notify the President and present the case to the council, at its first following meeting, which shall act upon it.

LOCAL RULES.

NEW YORK SECTION.

1. The officers of the New York Section of the Mining and Metallurgical Society of America shall be a chairman, a vice-chairman and a secretary, who shall be elected at the first meeting after the summer of each year, and shall hold office for one year from that time. These officers shall constitute the executive committee of the section.

2. The expenses incurred by the section shall be divided equally among all its members, and shall be payable at such times as the executive committee shall name.

3. In the absence of the chairman and vice-chairman, the meeting shall elect a chairman *pro tem,* to serve at that meeting. In the absence of the secretary, the chairman shall appoint an acting secretary to serve for that meeting.

4. The secretary shall keep a record of the proceedings of the meetings, and immediately after each meeting shall forward to the general secretary of the Society a report of the proceedings.

5. The presence of seven members of the section at a meeting shall constitute a quorum.

6. Members shall have the privilege of bringing guests to ordinary meetings of the section, but not to meetings previously announced as executive.

PHILADELPHIA SECTION

1. The officers of the Philadelphia Section of the Mining and Metallurgical Society of America shall be a chairman and a secretary, who shall be elected at the first meeting after the summer of each year, and shall hold office for one year after that time.

2. The expenses incurred by the section shall be equally divided among all members of the section, and shall be payable at such times as the chairman may name.

3. In the absence of the chairman, a meeting shall elect a chairman *pro tem.* to serve at that meeting. In the absence of the secretary, the chairman shall appoint an acting secretary to serve for that meeting.

4. The secretary shall keep a record of the proceedings of the meetings, and immediately after each meeting shall forward to the general secretary of the Society a report of the proceedings.

5. The members of the section shall have the privilege of bringing guests to the meetings of the section.

ANNOUNCEMENT

Adopted by the Council and published in the first bulletin of the Society.

It has been decided by the council of the Mining and Metallurgical Society of America to issue to the members a monthly bulletin similar to this, which will record the proceedings of the Society. In presenting this, the first bulletin of the Society, it is deemed desirable to outline the purposes of the Society suggested in the preliminary correspondence among those who became the charter members and developed in the discussion at the organization meeting. It is contemplated that the Society will enter immediately into five principal fields of activity, as follows:

(1) The establishment of local sections, to promote acquaintance among the members, good fellowship, and the interchange of views respecting technical and professional matters. It is intended that these local sections shall hold frequent meetings, probably once a month, all of the sections to hold their meetings on the same day. It has been suggested that these meetings take the form of a dinner, or smoker, to be followed by conversation and discussion. Such action as may be taken upon matters of interest will be reported to the general secretary and published in the monthly bulletin of the Society. If in the opinion of the council of the Society any matter be of such general importance as to deserve discussion by all of the sections, they will be requested by the general secretary to take it up. In addition to the meetings of the local sections, there will be in each year at least one meeting of the whole Society.

(2) The determination of standards in engineering practice, such as is being done by the Institution of Mining and Metallurgy. The Institution has from time to time appointed committees to consider technical questions as to which there is confusion, with the view to recommending a standard of practice that all members of the Institution are urged to adopt. Among the questions that have been taken up by the Institution of Mining and Metallurgy are the definition of what constitutes the development of ore, the establishment of a standard of screens for use in screen analysis, and an agreement as to weights and measures commonly employed in mining and metallurgical work. Efforts to secure standardization and uniformity of methods have also been made by other technical societies. There is a great field for useful work in this direction, and it is considered to be one that the Mining and Metallurgical Society of America may profitably enter.

(3) The discussion of questions relating to professional practice and ethics, with a view to the gradual formulation of

rules for guidance, determined by the consensus of opinion in the Society. Mining and metallurgical engineers are accustomed to speak of themselves as professional men, but in their actions they often show that they do not seriously regard themselves as such. This may be due to a large extent to vagueness in ideas respecting professional propriety. Consequently, it is considered that the Mining and Metallurgical Society of America will serve a useful purpose in discussing details of professional practice, such as the relation between the engineer and his clients, the matter of contingent fees, the communication of gratuitous advice. These are merely a few matters which suggest themselves. It is considered that a discussion of such questions relating to professional practice and ethics will lead eventually to the establishment of a code of ethics, developing the brief but comprehensive treatise on this subject by Sir Francis Bacon in the preface to his "Maxims of the Law" as follows: "I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereunto."

(4) The discussion of questions of public policy in which the profession of mining engineering is directly concerned. There are many questions arising in connection with the federal and state governments, which have a direct bearing upon the interests of the mining and metallurgical engineer, just as in the case of other professional men. For example, there has lately been a movement in the State of New York to compel every analytical chemist to secure a license from the State before being permitted legally to practice his profession; similarly it has been suggested that the states should pass laws requiring mining engineers to be licensed. It is no part of the present purpose to discuss or put any weight upon these particular propositions; they are mentioned merely as examples of matters of public policy which come up from time to time, affecting the profession of mining and metallurgical engineering, in connection with which the profession has heretofore had no means of expressing the consensus of its opinion. The Mining and Metallurgical Society of America will be a medium for the expression of such opinions.

(5) Finally, it is intended that the Mining and Metallurgical Society of America shall be a strictly professional society, i. e., membership in it will be limited to the ranks of the mining and metallurgical engineers, and mining geologists. Serious qualifications are prescribed as a prerequisite to membership, and it is the purpose of the founders of the Society to maintain a high standard of personal character and professional ability among the membership. In pursuance of this policy, applications for membership will be subjected to rigid investigation in substantially the same way as is done by the American Society of Civil Engineers. It is hoped that

this will cause the Mining and Metallurgical Society of America soon to become recognized as representative of the best in the mining and metallurgical profession of North America. Membership in the Society obviously will not be an unqualified endorsement, but it will be a recognition of good standing among and by members of the profession, which in many ways will be useful. It is proposed in the list of members of the Society to print brief records of their professional careers.

CERTIFICATE OF INCORPORATION

We, the undersigned, being desirous of associating ourselves together as a non-stock membership corporation, for scientific, educational and social purposes, as hereinafter more particularly set forth and described, pursuant to and in conformity with the Acts of Legislature of the State of New York relating to membership in non-stock corporations, do hereby certify and declare that we are all of full age, all of us are citizens of the United States, two of us are residents of the City, County and State of New York, and one of us is a resident of the City and State of New York and all of us have had at least eight years' practical or professional experience, including not less than five years of responsibility in mining or allied lines of work.

We do further certify and declare that the particular objects for which this corporation is to be formed, and the qualifications required for active membership therein are as follows; viz.,

First. To bring together, as Honorary Members and Members, those who are qualified by knowledge, experience and honorable standing acquired by at least eight years of practical or professional experience, including not less than five years in positions of responsibility in mining or allied kinds of work, for the specific purpose of thereby advancing the particular objects of the Society, to wit: the conservation of mineral resources, the advancement of mining and metallurgical industries, the better protection of mine investors and mine workers, the increase of scientific knowledge, the encouragement of high professional ideals and ethics, and the cherishing of the spirit of brotherhood among its members.

Second. That the corporate name by which said corporation, hereby to be formed, shall be known and distinguished, is and shall be:—Mining and Metallurgical Society of America.

Third. That the territory in which the operations of said corporation are to be principally conducted is the United States of America, Canada and Mexico.

Fourth. That the principal office of said corporation shall be located in the Borough of Manhattan, City, County and State of New York.

Fifth. That the number of directors of the said corporation shall be fifteen.

Sixth. That the names and places of residence of the persons to be the directors of said corporation until the first annual meeting, are

Walter R. Ingalls, 505 Pearl Street, New York City.
Henry S. Munroe, Columbia University, New York City.
Robert H. Richards, Massachusetts Institute of Technology, Boston, Mass.
William A. Lathrop, 108 South Fourth Street, Philadelphia, Pa.
Henry M. Chance, 819 Drexel Building, Philadelphia, Pa.
William N. Page, 1863 Kalorama Road, Washington, D. C.
Horace V. Winchell, 505 Palace Building, Minneapolis, Minn.
Ernest R. Buckley, Rolla, Missouri.
J. Parke Channing, 42 Broadway, New York City.
Joseph Hyde Pratt, Chapel Hill, North Carolina.
Charles W. Goodale, care Boston & Montana Cons. C. & S. Mng. Co., Butte, Montana.
Philip Argall, 730 Majestic Building, Denver, Colorado.
Frederick W. Bradley, Crocker Building, San Francisco, Cal.
John C. Branner, Stanford University, Cal.
Samuel B. Christy, University of California, Berkeley, Cal.

Seventh. That the annual meeting of said corporation shall be held on the second Tuesday of January in each and every year.

Eighth. That the duration of the corporation shall be thirty years.

In Testimony Whereof, we have made, signed and sealed this certificate in duplicate, and have hereunto set our hands and affixed our respective seals this day of , one thousand nine hundred and ten.

(Signed) HENRY S. MUNROE, (Seal)
Columbia University, New York City.
(Signed) WALTER R. INGALLS, (Seal)
505 Pearl St., New York City.
(Signed) ROBERT H. RICHARDS, (Seal)
Massachusetts Institute of Technology, Boston, Mass.
(Signed) HENRY M. CHANCE, (Seal)
819 Drexel Bldg., Philadelphia, Pa.
(Signed) J. PARKE CHANNING, (Seal)
42 Broadway, New York City.

The above certificate was signed and acknowledged on dates between Nov. 18 and Nov. 28, 1910, and was filed with the Sectary of State of New York on Dec. 2, 1910, and in the County of New York on Dec. 5, 1910.

MEMBERS.

March 1, 1914.

Addicks, Lawrence.....Chrome, N. J.
Superintendent U. S. Metals Refining Co.
Aldridge, W. H. .....14 Wall St., New York
Managing Director, Inspiration Copper Company.
Allen, John H. .....82 Beaver St., New York City
Consulting Metallurgist, Knox & Allen.
Appleby, William R.....Minneapolis, Minn.
Prof. of Metallurgy, State University.
Argall, Philip.....First National Bank Bldg., Denver, Colo.
Consulting Mining Engineer.
Arnold, Ralph .....917 Union Oil Bldg., Los Angeles, Cal.
Consulting Geologist and Mining Engineer.
Austin, L. S. .....251 W. 2d North St., Salt Lake City, Utah
Consulting Metallurgist.
Bain, H. Foster .....420 Market St., San Francisco, Cal.
Editor, *Mining and Scientific Press.*
Ball, Sydney H.....71 Broadway, New York
Mining Geologist.
Barbour, Percy E.....Candor, N. C.
General Manager, Uwarra Mining Co.
Beeler, H. C. .....127 Fifteenth St., Denver, Colo.
Consulting Mining Engineer.
Bellinger, Herman C.....Cobar, N. S. W.
Metallurgical Engineer.
Benjamin, Edward H. .....75 Fremont St., San Francisco, Cal.
President, Joshua Hendy Iron Works.
Boutwell, J. M.....1323 de la Vina St., Santa Barbara, Cal.
Mining Geologist.
Bradley, F. W. .....Crocker Bldg., San Francisco, Cal.
President, Bunker Hill & Sullivan M. & C. Co.
Bradley, Philip Read.....Crocker Bldg., San Francisco, Cal.
Consulting Mining Engineer.
Branner, J. C.....Stanford University, Cal.
President, Stanford University.
Brayton, Corey C. .....Room 408, 311 California St., San Francisco, Cal.
Mining Engineer.
Bretherton, S. E.....220 Mills Bldg., San Francisco, Cal.
Consulting Mining Engineer; Mgr., Afterthought Copper Co.
Brock, Reginald W. .....Ottawa, Canada
Deputy Minister of Mines of Canada.
Brooks, A. H.....Washington, D. C.
Geologist, U. S. Geological Survey.
Brown, R. Gilman .....62 London Wall, London, E. C., England
Consulting Mining Engineer.
Browne, Ross E.....234 Perry St., Oakland, Cal.
Mining Engineer.
Buck, Stuart M.....Bramwell, W. Va.
Mining Engineer.
Burch, Albert.....Crocker Bldg., San Francisco, Cal.
Mining Engineer; Gen. Supt., Goldfield Cons. Mining Co.
Burgess, John A.....Wonder, Nev.
Supt., Nevada Wonder Min. Co.
Butters, Charles .....221 59th St., Oakland, Cal.
Mining Engineer and Metallurgist.

Caetani, Gelasio .....Crocker Bldg., San Francisco, Cal.
Consulting Mining and Metallurgical Engineer.

Cairns, F. I.....Houghton, Mich.
Supt., Michigan Smelting Co.

Canby, R. C. .....334 So. Main St., Wallingford, Conn.
Consulting Metallurgist.

Cates, Louis Shattuck.....Ray, Ariz.
Supt of Mines, Ray Consolidated Copper Co.

Catlin, Robert M.....Franklin Furnace, N. J.
Engineer, New Jersey Zinc Co.

Chance, H. M.....839 Drexel Bldg., Philadelphia, Pa.
Consulting Mining Engineer and Geologist.

Channing, J. Parke.....42 Broadway, New York City
Consulting Mining Engineer.

Chase, Charles A.....734 First National Bank Bldg., Denver, Colo.
Consulting Mining Engineer; Gen. Mgr., Liberty Bell Gold Min. Co.

Chase, Edwin E. .....1450 William St, Denver, Colo.
Mining Engineer

Christy, S. B.....Berkeley, Cal.
Prof. of Mining and Metallurgy, University of California.

Claghorn, C. R.....Tacoma, Wash.
Gen. Mgr., Northwestern Improvement Co.

Clark, C. D.....165 Broadway, New York
Mining Engineer, W. Rowland Cox & Staff.

Clark, W. B.....Baltimore, Md.
State Geologist; and Prof. of Geology, Johns Hopkins University.

Clements, J. Morgan .....20 Broad St., New York City
Mining Engineer and Geologist.

Clevenger, G. Howell.....Palo Alto, Cal.
Associate Prof. of Metallurgy, Stanford University.

Cobb, Collier.....Chapel Hill, N. C.
Prof. of Geology, University of North Carolina.

Collins, George E. .....420 Boston Bldg., Denver, Colo.
Mining Engineer.

Comstock, Theodore B. .....909 Van Nuys Bldg., Los Angeles, Cal.
Mining Engineer.

Conner, Eli T. .....1315 Stephen Girard Bldg., Philadelphia, Pa.
Consulting Mining Engineer.

Corning, Christopher R.....36 Wall St., New York City
Consulting Mining Engineer.

Cottrell, F. G.....2332 Fulton St., Berkeley, Cal.
Physical Chemist, U. S. Bureau of Mines.

Cowles, Alfred H.....Sewaren, N. J.
Metallurgist; Pres., Electric Smelting & Aluminum Co.

Cox, W. Rowland.....165 Broadway, New York City
Mining Engineer.

Crowell, Benedict.....407 Perry-Payne Bldg., Cleveland, O.
Consulting Mining Engineer.

Darton, N. H.....Washington, D. C.
Geologist, U. S. Geological Survey.

Derby, C. C.....Nevada City, Cal.
Mining Engineer.

d'Invilliers, E. V. .....518 Walnut St., Philadelphia, Pa.
Mining Engineer.

Dorr, John V. N. .....First Nat. Bank Bldg., Denver, Colo.
Consulting Metallurgical Engineer.

Douglas, James Stuart.....Douglas, Ariz.
Mine Owner and Banker.

Drake, Francis.....Box 249, Bulawayo, Rhodesia
Consulting Mining Engineer for Lewis & Marks; Gen. Mgr., Lonely Reef Gold Min. Co.

Drinker, Henry S.....South Bethlehem, Pa.
President, Lehigh University.

Drury, Walter M. .....165 Broadway, New York
Gen. Mgr., Mexican Mining Dept., American Smelting & Refining Co., etc.

DuBois, H. W.....302 Harrison Bldg., Philadelphia, Pa.
Mining Engineer.

Dufourcq, E. L.....Produce Exchange Building, New York
Mining Engineer.

Dumble, E. T.....2003 Main St., Houston, Tex.
Geologist.

Duncan, Murray M.....Ishpeming, Mich.
Gen. Mgr., Cleveland-Cliffs Iron Co.

Dwight, Arthur S.....29 Broadway, New York
President, Dwight & Lloyd Sintering Co., Inc.

Easton, Stanly A.....Kellogg, Idaho
Mining Engineer; Mgr., Bunker Hill & Sullivan M. & C. Co.

Eurich, Ernst F.....15 William St., New York City
Consulting Mining Engineer.

Fairchild, S. E., Jr.....530 Land Title Bldg., Philadelphia, Pa.
Mining Engineer.

Farish, John B.....603 Colorado Bldg., Denver, Colo.
Consulting Mining Engineer.

Finch, John Wellington.....730 Symes Bldg., Denver, Colo.
Consulting Mining Geologist and Engineer.

Finlay, J. R.....52 William St., New York City
Consulting Mining Engineer.

Fitch, Walter.....Eureka, Utah
Pres. and Gen. Mgr., Chief Cons. Mining Co., etc.

Foote, Arthur DeWint.....Grass Valley, Cal.
Consulting Engineer, North Star Mines Co.

Fowler, Samuel S.....Drawer 1024, Nelson, B. C.
Mining Engineer and Metallurgist.

Fuller, John T.....Box 393, Little Rock, Ark.
Consulting Mining Engineer, Ark. Bureau of Mines, Manufactures and Agriculture.

Fulton, Charles H.....Cleveland, O.
Prof. of Metallurgy, Case School of Applied Science.

Garrison, F. Lynwood.....982 Drexel Bldg., Philadelphia, Pa.
Mining Engineer.

Gemmell, Robert C.....McCornick Bldg., Salt Lake City, Utah
Gen. Mgr., Utah Copper Co.

Goodale, Charles W.....Butte, Mont.
Mgr., B. & M. Dept., Anaconda Copper Mining Co.

Gormley, Samuel J. .....3063 E. 6th St., Los Angeles, Cal.
Consulting Metallurgist.

Gottsberger, B. Britton.....Miami, Ariz.
Gen. Mgr., Miami Copper Co.

Grant, U. S. .....Evanston, Ill.
Prof. of Geology, Northwestern University.

Graton, Louis Caryl.....Cambridge, Mass.
Sec'y and Treas., Copper Producers' Assn.; Prof. of Mining Geology, Harvard University.

Griffith, William.....Coal Exchange Bldg., Scranton, Pa.
Mining Engineer.

Guernsey, F. W.....Thompson, Nev.
Mining Engineer, Mason Valley Mines Co.

Haas, Frank.....Fairmont, W. Va.
Consulting Engineer, Consolidation Coal Co.
Halberstadt, Baird.....Pottsville, Pa.
Mining Geologist.
Hardinge, H. W.....50 Church St., New York
Consulting Mining and Metallurgical Engineer.
Hartranft, Samuel S.....Norristown, Pa.
Metallurgical Engineer.
Hayes, C. Willard.....Tampico, Tamps., Mex.
Gen. Mgr., Exploitation Dept., Cia. Mexicana de Petroleo "El Aguila."
Hellmann, Fred.....Chuquicamata, via Antofagasta, Chile
Consulting Mining Engineer.
Hersam, Ernest A.....Berkeley, Cal.
Associate Prof. of Metallurgy, University of California.
Hess, Frank L.....Washington, D. C.
Geologist, U. S. Geological Survey.
Hill, Frank A.....512 S. Centre St., Pottsville, Pa.
Mining Engineer.
Hixon, Hiram W.....Aire Libre, Peubla, Mex.
Supt., Teziutlan Copper Co.
Hoffmann, Aug. O.....Handtverkargatan 15, Stockholm, Sweden
Mining and Metallurgical Engineer.
Hofman, H. O.....Boston, Mass.
Prof. of Metallurgy, Mass. Inst. of Technology.
Holden, Edwin C.....Madison, Wis.
Consulting Engineer; Prof. of Mining, University of Wisconsin.
Holmes, Joseph A.....Washington, D. C.
Director, United States Bureau of Mines.
Hoover, Herbert C.....71 Broadway, New York
Consulting Mining Engineer.
Howe, Ernest .....77 Rhode Island Ave., Newport, R. I.
Geologist.
Huntoon, Louis D.....115 Broadway, New York
Consulting Mining Engineer.
Hutchins, J. P.....341 Salisbury House, London, E. C., England
Mining Engineer.
Hutchinson, E. S. .....Newtown, Pa.
Civil and Mining Engineer.
Ingalls, W. R.....505 Pearl St., New York City
Mining Engineer; Editor, *Engineering and Mining Journal.*
Irving, J. D.....New Haven, Conn.
Mining Engineer; Prof. of Geology, Sheffield Scientific School.
Jackling, Daniel C.....Salt Lake City, Utah
Vice-Pres., Utah Copper Co.
Jennings, Hennen.....2221 Massachusetts Ave., Washington, D. C.
Consulting Mining Engineer.
Jennings, Sidney J.....42 Broadway, New York City
Vice-Pres., U. S. Smelting, Refining and Mining Co.
Jopling, James Edmund .....321 Cedar St., Marquette, Mich.
Chief Engineer, Cleveland-Cliffs Iron Co.
Keating, John B. .....Winthrop, Shasta Co., Cal.
Mgr., Bully Hill Copper Mg. and Smg. Co.
Keith, Frank A. .....1219 Hollingsworth Bldg., Los Angeles, Cal.
Consulting Mining Engineer.
Kelly, William .....Vulcan, Mich.
Gen. Mgr., Penn. Iron Mining Co. and Republic Iron Co.
Kemp, J. F. .....New York City
Prof. of Geology, Columbia University.

Kennedy, Eugene P. ..... Treadwell, Alaska
Asst. Supt., Alaska-Treadwell Gold Mining Co.
Keyes, Charles R. ..... 944 Fifth St., Des Moines, Iowa
Geologist.
Kimball, Edwin B. ..... 284 Mountain Ave., Piedmont, Cal.
Gen. Mgr., Esperanza Consolidated Oil Co.
Kinzie, Robert Allen ..... Treadwell, Alaska
Gen. Supt., Alaska-Treadwell, Alaska-Mexican, Etc.
Kirby, Edmund Burgis ..... 918 Security Bldg., St. Louis, Mo.
Consulting Mining and Metallurgical Engineer.
Knox, H. H. ..... 82 Beaver St., New York City
Mining Engineer.
Ladd, George E. ..... State College, N. M.
President, New Mex. College of Agriculture and Mechanic Arts.
Laird, George A. ..... Cobar, N. S. W.
Gen. Supt. of Mines; Great Cobar, Ltd.
Lawall, Elmer H. ..... Wilkesbarre, Pa.
Mining Engineer.
Lawrence, Benjamin B. ..... 60 Wall St., New York
Consulting Mining Engineer.
Lawson, A. C. ..... Berkeley, Cal.
Prof. of Geology, University of California.
Lawton, Charles L. ..... Hancock, Mich.
Gen. Mgr., Quincy Mining Co.
Leggett, Thomas H. ..... 165 Broadway, New York
Consulting Mining Engineer, American Smelting & Refining Co.
Lessner, Charles B. ..... Carril, Spain
Metallurgist.
Lewis, J. Volney ..... New Brunswick, N. J.
Prof. of Geology and Mineralogy, Rutgers College.
Liddell, Donald M. ..... 505 Pearl St., New York
Associate editor, *Engineering and Mining Journal.*
Lindgren, Waldemar ..... Boston, Mass.
Head of Dept. of Geology, Mass. Inst. of Technology.
Lindsley, Halstead ..... Idaho Springs, Colo.
Mining Engineer; Mgr., The Pozo Gilpin Co.
Loring, Frank C. ..... Home Life Bldg., Toronto, Ont.
Mgr., Wettlaufer-Lorrain Silver Mines, Ltd.
Lyman, Benjamin Smith ..... 708 Locust St., Philadelphia, Pa.
Mining Engineer.
Lyon, Dorsey A. ..... Box 83, Oakland Sta., Pittsburgh, Pa.
Metallurgist.
McClelland, James F. ..... Drawer C., Yale Sta., New Haven, Conn.
Prof. of Mining Engineering, Yale University.
McCreath, Andrew S. ..... Harrisburg, Pa.
Consulting Chemist.
MacNaughton, James W. ..... Calumet, Mich.
Gen. Mgr., Calumet & Hecla Mining Co.
Magnus, Benjamin ..... Mount Morgan, Queensland
Gen. Mgr., Mount Morgan Gold Mining Co.
Malcolmson, J. W. ..... 3728 Main St., Kansas City, Mo.
Mining Engineer.
Mann, William S. ..... Valle de los Angeles, Honduras, C. A.
Mining Engineer.
Mein, William Wallace ..... 43 Exchange Pl., New York
Gen. Mgr., Canadian Mining & Exploration Co., Ltd.
Melzer, Gustav Emil ..... Baker City, Ore.
Consulting Mining Engineer and Metallurgist.

Mendenhall, W. C.....Washington, D. C.
Geologist, U. S. Geological Survey.
Mercer, John W.....15 Broad St., New York City
Mine Manager.
Merriam, W. N.....Duluth, Minn.
Geologist.
Merrill, Chas. W.....121 Second St., San Francisco, Cal.
Consulting Metallurgical Engineer.
Merrill, F. J. H.....624 Citizens National Bank Bldg., Los Angeles, Cal.
Consulting Mining Engineer.
Metcalfe, G. W.....Kennett, Cal.
Manager, Mammoth Copper Mining Co.
Moore, P. N.....611 Merchants' Laclede Bldg., St. Louis, Mo.
Mining Engineer.
Morley, F. H.....2616 Channing Way, Berkeley, Cal.
Mining Engineer.
Mudd, Seeley W.....1208 Hollingsworth Bldg., Los Angeles, Cal.
Mining Engineer.
Munro, Charles H.....1057 Monadnock Bldg., San Francisco, Cal.
Gen. Mgr., Wild Goose Mining and Trading Co.
Munroe, H. S.....New York City
Prof. of Mining, Columbia University.
Newsom, John F.....Stanford University, Cal.
Associate Prof. of Mining, Stanford University.
Nichols, Ralph.....Gilmore, Idaho
Consulting Mining and Metallurgical Engineer.
Norris, Robert Van A.....520 Second Nat. Bank Bldg., Wilkesbarre, Pa.
Consulting Mining Engineer.
Noyes, William S.....819 Mills Bldg., San Francisco, Cal.
Pres., Butte Dredging Co., El Oro Dredging Co.
Nutter, Edward H.....Merchants' Exchange Bldg., San Francisco, Cal.
Chief Engineer, Minerals Separation American Syndicate, Ltd.
Oliver, Edwin Letts.....503 Market St., San Francisco, Cal.
Consulting Metallurgist; Mgr., Oliver Continuous Filter Co.
Packard, George A.....50 Congress St., Boston, Mass.
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Page, William N.....1863 Kalorama Road, Washington, D. C.
Mining Engineer, Pres., Gauley Mt. Coal Co., Ansted, W. Va.
Parker, E. W.....Washington, D. C.
Statistician, U. S. Geological Survey.
Parker, Richard A.....929 Foster Bldg., Denver, Colo.
Consulting Mining Engineer.
Parsons, Floyd W.....505 Pearl St., New York City
Editor, *Coal Age*.
Patterson, G. S.....Vivian, McDowell Co., W. Va.
Mining Engineer.
Payne, Henry M.....50 Church St., New York
Chief of Staff, Stephen T. Williams & Staff.
Peele, Robert.....New York City
Prof. of Mining, Columbia University.
Penrose, R. A. F., Jr.....460 Bullitt Bldg., Philadelphia, Pa.
Consulting Mining Geologist.
Perry, Oscar B.....165 Broadway, New York City
Gen. Mgr., Yukon Gold Co.
Pomeroy, William A.....600 W. 115th St., New York City
Asst. Mgr. of Mines, New Jersey Zinc Co.
Potter, W. B.....713 Clark Ave., St. Louis, Mo.
Mining Engineer; Mgr., St. Louis Sampling & Testing Works.
Pratt, Joseph H.....Chapel Hill, N. C.
State Geologist and Prof. of Geology, Univ. of North Carolina.

Prichard, William A.....225 California St., San Francisco, Cal.
Mining Engineer.

Pringle, Charles A.....Russ Bldg., San Francisco, Cal.
Mining Engineer.

Pumpelly, Raphael.....Newport, R. I.
Geologist.

Queneau, Augustin Leon Jean.....929 Chestnut St., Philadelphia, Pa.
Metallurgical Engineer, Wetherill Finished Castings Co.

Rainsford, Ralph S.....Jackson, Cal.
Gen. Mgr., Argonaut Mining Co., and Golden Rule Mines Co.

Rawlings, Stuart L.....San Dimas, Dgo., Mexico
Mgr., San Luis Mining Co.

Read, Thomas Thornton.....1308 Woolworth Bldg., New York
Associate Editor, *Mining and Scientific Press.*

Requa, M. L.....1026 Crocker Bldg., San Francisco, Cal.
Mining Engineer.

Rice, George S. .....40th and Butler Sts., Pittsburgh, Pa.
Mining Engineer, U. S. Bureau of Mines.

Richards, Robert H.....Boston, Mass.
Prof. of Mining and Metallurgy, Mass. Inst. of Technology.

Rickard, Forbes.....508 Equitable Bldg., Denver, Colo.
Mining Engineer.

Riordan, D. M.....165 Broadway, New York City
Managing Director, La Grange Hydraulic Gold Mine, Etc.

Riter, George W.....Deseret Nat. Bank Bldg., Salt Lake City, Utah
Sec'y and Mgr., Eureka Hill Mining Co.

Roberts, Milnor.....University Sta., Seattle, Wash.
Professor of Mining Engineering and Metallurgy, University of Washington.

Robertson, William Fleet.....Department of Mines, Victoria, B. C.
Provincial Mineralogist of British Columbia.

Rogers, Alexander P.....60 Broadway, New York
Consulting Mining Engineer.

Rogers, Allen H.....201 Devonshire St., Boston, Mass.
Consulting Mining Engineer.

Rohn, Oscar .....Butte, Mont.
Mining Engineer.

Ropp, Alfred von der.....233 Broadway, New York
Representative, Cons. Gold Fields of South Africa, Ltd.; also Mgr., Gold Fields American Development Co., Ltd.

Sales, Reno H.....Box 457, Butte, Mont.
Geologist for Amalgamated Copper Co.

Sanders, Richard H.....605 Drexel Bldg., Philadelphia, Pa.
Mining Engineer.

Saulles, C. A. H., de.....165 Broadway, New York
Vice-Pres. and Gen. Mgr., U. S. Zinc Co.; Met. Engr., American Smelting & Refining Co.

Schrader, F. C.....Washington, D. C.
Geologist, U. S. Geological Survey.

Sharpless, F. F.....52 Broadway, New York City
Mining Engineer.

Shaw, Silas Frederick.....Charcas, S. L. P., Mex.
Supt., Mina Tiro General.

Shockley, W. H.....First Nat. Bank Bldg., San Francisco, Cal.
Mining Engineer.

Sizer, F. L.....915 First Nat. Bank Bldg., San Francisco, Cal.
Gen. Supt., Mascot Copper Co.

Smith, E. A. Cappelen .....165 Broadway, New York
Consulting Metallurgical Engineer, M. Guggenheim's Sons.

Smith, Franklin W.....Bisbee, Ariz.
Consulting Mining Engineer.

Smith, George Otis.....Washington, D. C.
Director U. S. Geological Survey.

Smith, William A.....Herculaneum, Mo.
Mgr., St. Joseph Lead Co.

Smyth, H. L.....Cambridge, Mass.
Prof. of Mining and Metallurgy, Harvard University.

Spaulding, M. B.....Oliver Bldg., Pittsburgh, Pa.
Mgr., Pittsburgh District of Crocker-Wheeler Co.

Sperr, Frederick W.....Houghton, Mich.
Prof. of Mining Engineering, Michigan College of Mines.

Spilsbury, E. G.....45 Broadway, New York City
Mining Engineer.

Spurr, J. E.....571 Bullitt Bldg., Philadelphia, Pa.
Vice-Pres., Tonopah Mining Co.

Starr, George W.....Grass Valley, Cal.
Supt., Empire and Pennsylvania Mines.

Staunton, Wm. F.....609 Central Bldg., Los Angeles, Cal.
Consulting Mining Engineer.

Stone, George C.....55 Wall St., New York City
Chief Engineer, New Jersey Zinc Co.

Stonestreet, George D.....Haileybury, Ont.
Consulting Mining Engineer.

Stoughton, Bradley.....29 W. 39th St., New York
Sec'y, Am. Inst. of Min. Engrs.

Stow, Audley H.....Pocahontas, Va.
Chief Engineer, Pocahontas Collieries Co.

Susmann, Julius H.....42 Broadway, New York
Consulting Mining Engineer.

Sussman, Otto.....52 Broadway, New York City
Consulting Mining Engineer.

Symmes, Whitman.....Virginia City, Nev.
Supt., Mexican Gold & Silver Mining Co.

Thacher, Arthur.....Roe Bldg., St. Louis, Mo.
Mining Engineer.

Turner, Henry W.....62 London Wall, London, E. C., England
Mining Geologist.

Tyrrell, Joseph B.....534 Confederation Life Chambers, Toronto, Ontario
Mining Geologist and Consulting Engineer.

Van Mater, Joseph A.....55 Wall St., New York City
Manager of Mines, New Jersey Zinc Co.

Walker, Arthur L.....New York City
Prof. of Metallurgy, Columbia University.

Washington, Henry S.....Singer Bldg., New York City
Mining Geologist.

Waterman, Douglas.....Divisadero, Salvador, C. A.
c-o Butters Divisadero Co.

Weed, Walter Harvey.....42 Broadway, New York City
Consulting Mining Engineer.

Weeks, Francis D.....52 Broadway, New York City
Metallurgical Engineer, American Metal Co.

Welch, J. Cuthbert.....Box 248, Tooele, Utah
Metallurgical and Mining Engineer.

Westervelt, William Young.....17 Madison Ave., New York City
Mining Engineer.

Wethey, Arthur H.....37 Madison Ave., New York City
Mining Engineer.

Whitaker, Orvil Robert.....932 Equitable Bldg., Denver, Colo.
Consulting Engineer of Mines.
White, Rush J. .....Wallace, Ida.
Supt. of Mines and Chief Engr., Federal Mining & Smelting Co.
White, Robeson T. .....Rancagua, Chile
Mining Engineer
Wiard, Edward S. .....417 Boston Bldg., Denver, Colo.
Mining Engineer.
Wilkins, H. A. J.....142 E. 18th St., New York
President, Mines Management Co.
Williams, Ralph B.....96 High St., Newburyport, Mass.
Mining Engineer.
Wilmot, H. C. .....Aroroy, Masbate, P. I.
Mgr., Syndicate Mining Co.
Wilson, William A. .....Salt Lake City, Utah
Consulting Mining Engineer.
Winchell, Alexander N. .....Madison, Wis.
Prof. of Geology, University of Wisconsin.
Winchell, H. V. .....505 Palace Bldg., Minneapolis, Minn.
Geologist.
Wright, Louis A. .....813 Mills Bldg., El Paso, Tex.
Consulting Mining Engineer.
Yeatman, Pope .....165 Broadway, New York City
Mining Engineer.
Young, George J. .....Minneapolis, Minn.
Prof. of Mining, Minn. State School of Mines.
Total members 242

DECEASED MEMBERS.

Bettles, Alfred J. .....Died Aug. 3, 1911
Blake, William P. .....Died May 22, 1910
Buckley, E. R. .....Died Jan. 19, 1912
Carpenter, Franklin R. .....Died April 1, 1910
Dudley, Charles B. .....Died Dec. 21, 1909
Emmons, Samuel Franklin .....Died Mar. 28, 1911
Forrester, Robert .....Died Dec. 20, 1910
Havard, F. T.....Died May 22, 1913
Lathrop, W. A. .....Died Apr. 12, 1912
Maynard, George W. .....Died Feb. 13, 1913
Patch, Maurice B.....Died Dec. 2, 1913
Shelby, Charles F. .....Died Jan. 25, 1911
Sutton, Linton B. .....Died June 11, 1911
Thompson, Heber S. .....Died Mar. 9, 1911

MEMBERSHIP

GEOGRAPHICALLY ARRANGED.

ALASKA
TREADWELL
Kennedy, E. P.
Kinzie, R. A.

ARIZONA
BISBEE
Smith, F. W.
DOUGLAS
Douglas, J. S.
MIAMI
Gottsberger, B. B.
RAY
Cates, L. S.

ARKANSAS
LITTLE ROCK
Fuller, J. T.

CALIFORNIA
BERKELEY
Christy, S. B.
Cottrell, F. G.
Hersam, E. A.
Lawson, A. C.
Morley, F. H.
GRASS VALLEY
Foote, A. DeW.
Starr, G. W.
JACKSON
Rainsford, R. S.
KENNETT
Metcalfe, G. W.
LOS ANGELES
Arnold, R.
Comstock, T. B.
Gormley, S. J.
Keith, F. A.
Merrill, F. J. H.
Mudd, S. W.
Staunton, W. F.
NEVADA CITY
Derby, C. C.
OAKLAND
Browne, R. E.
Butters, C.
PALO ALTO
Clevenger, G. H.
PIEDMONT
Kimball, E. B.
SAN FRANCISCO
Bain, H. F.
Benjamin, E. H.
Bradley, E. W.
Bradley, P. R.
Brayton, C. C.
Bretherton, S. E.
Burch, A.
Caetani, G.
Merrill, C. W.
Munro, C. H.
Noyes, W. S.
Nutter, E. H.
Oliver, E. L.
Prichard, W. A.
Pringle, C. A.
Requa, M. L.
Shockley, W. H.
Sizer, F. L.
SANTA BARBARA
Boutwell, J. M.
STANFORD UNIVERSITY
Branner, J. C.
Newsom, J. F.
WINTHROP
Keating, J. B.

COLORADO
DENVER
Argall, P.
Beeler, H. C.
Chase, C. A.
Chase, E. E.
Collins, G. E.
Dorr, J. V. N.
Farish, J. B.
Finch, J. W.
Parker, R. A.
Rickard, F.
Whitaker, O. R.
Wiard, E. S.
IDAHO SPRINGS
Lindsley, H.

CONNECTICUT
NEW HAVEN
Irving, J. D.
McClelland, J. F.
WALLINGFORD
Canby, R. C.

IDAHO
GILMORE
Nichols, R.
KELLOGG
Easton, S. A.
WALLACE
White, R. J.

ILLINOIS
EVANSTON
Grant, U. S.

IOWA
DES MOINES
Keyes, C. R.

MARYLAND
BALTIMORE
Clark, W. B.

MASSACHUSETTS
BOSTON
Hofman, H. O.
Lindgren, W.
Packard, G. A.
Richards, R. H.
Rogers, A. H.
CAMBRIDGE
Graton, L. C.
Smyth, H. L.
NEWBURYPORT
Williams, R. B.

MICHIGAN
CALUMET
MacNaughton, J. W.
HANCOCK
Lawton, C. L.
HOUGHTON
Cairns, F. I.
Sperr, F. W.
ISHPEMING
Duncan, M. M.

MARQUETTE
Jopling, J. E.
VULCAN
Kelly, W.

MINNESOTA
DULUTH
Merriam, W. N.
MINNEAPOLIS
Appleby, W. R.
Winchell, H. V.
Young, G. J.

MISSOURI
HERCULANEUM
Smith, W. A.
KANSAS CITY
Malcolmson, J. W.
ST. LOUIS
Kirby, E. B.
Moore, P. N.
Potter, W. B.
Thacher, A.

MONTANA
BUTTE
Goodale, C. W.
Rohn, O.
Sales, R. H.

NEVADA
THOMPSON
Guernsey, F. W.
VIRGINIA CITY
Symmes, W.
WONDER
Burgess, J. A.

NEW JERSEY
CHROME
Addicks, L.
FRANKLIN FURNACE
Catlin, R. M.
NEW BRUNSWICK
Lewis, J. V.
SEWAREN
Cowles, A. H.

NEW MEXICO
STATE COLLEGE
Ladd, G. E.

NEW YORK
NEW YORK
Aldridge, W. H.
Allen, J. H.
Ball, S. H.
Channing, J. P.
Clark, C. D.
Clements, J. M.
Corning, C. R.
Cox, W. R.
Drury, W. M.
Dufourcq, E. L.
Dwight, A. S.
Eurich, E. F.
Finlay, J. R.
Hardinge, H. W.
Hoover, H. C.
Huntoon, L. D.
Ingalls, W. R.
Jennings, S. J.
Kemp, J. F.
Knox, H. H.
Lawrence, B. B.
Leggett, T. H.
Liddell, D. M.
Mein, W. W.
Mercer, J. W.
Munroe, H. S.
Parsons, F. W.
Payne, H. M.
Peele, R.
Perry, O. B.
Pomeroy, W. A.
Read, T. T.
Riordan, D. M.
Rogers, A. P.
Ropp, A. von der
Saulles, C. A. H. de
Sharpless, F. F.
Smith, E. A. C.
Spilsbury, E. G.
Stone, G. C.
Stoughton, B.
Susmann, J. H.
Sussman, O.
Van Mater, J. A.
Walker, A. L.
Washington, H. S.
Weed, W. H.
Weeks, F. D.
Westervelt, W. Y.
Wethey, A. H.
Wilkins, H. A. J.
Yeatman, P.

NORTH CAROLINA
CANDOR
Barbour, P. E.
CHAPEL HILL
Cobb, C.
Pratt, J. H.

OHIO
CLEVELAND
Crowell, B.
Fulton, C. H.

OREGON
BAKER CITY
Melzer, G. E.

PENNSYLVANIA
HARRISBURG
McCreath, A. S.
NEWTOWN
Hutchinson, E. S.
NORRISTOWN
Hartranft, S. S.
PHILADELPHIA
Chance, H. M.
Conner, E. T.
d'Invilliers, E. V.
Du Bois, H. W.
Fairchild, S. E., Jr.
Garrison, F. L.
Lyman, B. S.
Penrose, R. A. F., Jr.
Queneau, A. L.
Sanders, R. H.
Spurr, J. E.
PITTSBURGH
Lyon, D. A.
Rice, G. S.
Spaulding, M. B.
POTTSVILLE
Halberstadt, B.
Hill, F. A.
SCRANTON
Griffith, W.
SOUTH BETHLEHEM
Drinker, H. S.
WILKESBARRE
Lawall, E. H.
Norris, R. V.

RHODE ISLAND
NEWPORT
Howe, E.
Pumpelly, R.

TEXAS
EL PASO
Wright, L. A.

HOUSTON
Dumble, E. T.

UTAH
TOOELE
Welch, J. C.
EUREKA
Fitch, W.
SALT LAKE CITY
Austin, L. S.
Gemmell, R. C.
Jackling, D. C.
Riter, G. W.
Wilson, W. A.

VIRGINIA
POCAHONTAS
Stow, A. H.

WASHINGTON
SEATTLE
Roberts, M.
TACOMA
Claghorn, C. R.

WEST VIRGINIA
BRAMWELL
Buck, S. M.
FAIRMONT
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Holmes, J. A.
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MASBATE
Wilmot, H. C.

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NELSON, B. C.
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VICTORIA, B. C.
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Shaw, S. F.
SAN DIMAS, DGO.
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Lessner, C. B.
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Bellinger, H. C.
Laird, G. A.
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Brown, R. G.
Hutchins, J. P.
Turner, H. W.
MT. MORGAN, Q'NSL'ND
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